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CONTENTS OF VOLUME XXI., PT. I.

[PROC. ROY. SOC. VICTORIA, 21 (N.S.), PT. I., 1908].

ART. I.—*On the Longevity of Seeds.*

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With an Appendix by Miss Jean White, M.Sc.

(Published with the permission of the Hon. G. Swinburne, M.L.A., Minister for Agriculture).[1]

[Read 12th March, 1908].

Probably few sections of human knowledge contain a larger percentage of contradictory, incorrect and misleading observations than prevail in the works dealing with this subject, and, although such fables as the supposed germination of mummy wheat have long since been exploded, equally erroneous records are still current in botanical physiology. In addition there are considerable differences of opinion as to the causes which determine the longevity of seeds in the soil or air. The works of de Candolle, Duvel and Becquerel are the most accurate and comprehensive dealing with the question, and in addition Vilmorin has published very useful data in regard to the seeds of culinary vegetables. The subject is still, however, in an incomplete and fragmentary condition.

Shortly after my arrival in Melbourne, in a locked cupboard received from the late Prof. McCoy's old Natural History department, two large packages of named seeds were found, including over 600 different sorts. The packets were all numbered and named, and accompanied by a list, dated 1850, and marked "Seeds of Kew." The paper, however, of the list and packets

1 With the aid of a special grant from the Agricultural Department.

bore an 1856 watermark, and on reference to Kew, Dr. Prain considered the 1850 to be probably an error for 1856. On further investigation it was found that when the University of Melbourne was founded, Baron von Mueller sent these seeds to Prof. McCoy for the University garden, but as the garden was not ready the seeds were placed on one side and replaced later by fresh sendings. The original 1856 sets of seeds became subject to Prof. McCoy's remarkable powers of collecting and storing material, and remained unopened and untouched in a dry, airy, dark cupboard, shielded completely from vermin, until the University's 50-year Jubilee in 1906.

These seeds were tested at first in soil, but this was soon found to be unsatisfactory. Subsequently all were soaked in water after counting, hard seeds specially treated to make them swell, and then placed on filter paper in glass dishes kept in a germination chamber. The elaborate methods used by Becquerel are less satisfactory than a daily inspection of the material, and renewal of the filter paper or washing whenever necessary. All the seeds were, before being finally rejected as non-germinable, tested by crushing or hand-lens examination. Prior to this they were exposed to light and to a raised temperature of 30-40 deg. C. for some time, whereas during the early period of each test every batch of seed was approximately at a temperature of 25 deg. C., and in feeble light or darkness.

About 200 sets of 10-year-old seeds were obtained from Mr. Maiden, and Mr. Baker, of Sydney, and from Prof. Stirling, of Adelaide. The remainder came from the National Herbarium, either from dated specimens or from stored dated seed which had been used in the past for exchange purposes. A total of nearly 3000 tests were made, although many, being made in duplicate, appear once only in the alphabetical lists. With these are incorporated all the previous records I could find, so that these could be verified or corrected, as might be the case, and the list made as comprehensive as possible. In addition the list includes a number of observations by Darwin, Berkeley, Giglioli, Duvel and others on the resistance of seeds to sea-water, and to other injurious agencies or conditions, including burial in the soil since these are factors in longevity.

The first column gives the name of the seed, the second the age in years, the third the number of seeds tested[1], the fourth the percentage germinating (which in nearly all previous records is omitted!), and the fifth the author making the observation and any remarks as to treatment. If no author's name is given the observation is original. To save frequent footnotes, a reference list of the chief works consulted is appended beneath.

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	Years old.	No. of Seeds.	Per cent. Germ.	
Abrus, sp.	10	26	nil	Nobbe's, Samen Kunde.
Abutilon Avicennae, Gaertn.	12		15	
ditto	12		48	
var. Behriana, F. v. M.	20	150	8	
ditto	57	45	6	Sw. after ½ hr. in acid.[1]
ditto		150	2	Sw. in water.
Fraseri, Walp., var. diplotrichum, F. v. M.	47	15	nil	Sw. water.
indicum, Sweet	12		12	Nobbe's, Samen Kunde.
Mitchelli, Benth.	10	50	44	All sw. after 2½ hr. in acid.
mollissimum, Sweet	15	20	nil	A. de C.
oxycarpum, F. v. M.	14	100	12	Swelled in water.
		100	52	After 1¼ hr. in acid.
Acacia acinacea, Lindl., var. Latrobei.	51	28	3.6	After 6 months in soil.
alata, R. Br.	30	15	nil	Sw. water.
		8	12	Sw. after 1 hr. in acid.
aneura, F. v. M.	46	20	nil	All sw. water.
ditto	20	8	12.5	Sw. water.
		8	100	Sw. after 2 hr. in acid.
armata, R. Br.	51	45	11	5 m. soil, then in warm water 1 week.
aspera, Lindl.	54	30	nil	All sw. water.
bossiaeoides, A. Cunn.	57	25	nil	Sw. in water.
		18	5.5	In acid 2 hr.

1 The acid used was concentrated sulphuric (H_2SO_4).

D.=Darwin; A. de C.=A. de Candolle; sw.=swelled; hr.=hours; d.=days; m.=months: des.=desiccated; supp.=supposed.

Where two records follow one age, these are from the same batch of seed, of which some have swollen in water, others only after treatment with acid.

	Years old.	No. of Seeds.	Per cent. Germ.	
brachybotrya, Benth.	57	50	nil	Swelled water.
		14	21.4	In acid 2 hr.
calamifolia, Sweet.	18	5	80	2 hr. in acid.
calamifolia, Sweet., var. Wilhelmiana, F. v. M.	58	16	nil	All sw. in water.
cibaria, F. v. M.	47	19	nil	All sw. water. No signs of life.
cornigera, Willd.	36		some	Becquerel.
cultriformis, A. Cunn.	50	24	nil	
dealbata, Link.	15	2	nil	Sw. in water.
		28	67.8	In acid 2 hr.
decurrens, Willd.	17	60	63	Sw. only after 2 hr. in acid.
diffusa, Lindley.	29	2	nil	Sw. in water.
		13	15	Sw. after 2 hr in acid.
ditto	57	32	9	Sw. after 3 hr. in acid.
ditto	59	10	10	Sw. after 18 hr. in acid.
diffusa, Lindley, var. cuspidata, A. Cunn.	50	30	nil	
ditto	55	20	nil	In acid 2 hr.
doratoxylon, Cunn.	20	33	3	Sw. water.
		34	9	Sw. after 1½ hr. in acid.
elata, A. Cunn.	30	19	16	Sw. after 3 hr. in acid.
Farnesiana, Willd.	15	20	5 to 15	A. de C.
genistoides, A. Cunn.	30	10	nil	Sw. after 1 hr. in acid. Cotyledons of 1 living.
glaucescens, Willd.	16	10	40	2 hr. in acid.
ditto	16	1	nil	Sw. water.
		32	6	Sw. after 2 hr. in acid.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	20	12	nil	Sw. water.
		14	93	Sw. only after 2 hr. in acid.
hakeoides, A. Cunn.	57	18	nil	All sw. water.
homalophylla, A. Cunn.	47	25	nil	All sw. water.
lanigera, A. Cunn.	20	2	nil	Sw. water.
		34	26	Sw. after 2 hr. in acid.
leiophylla, Benth.	30	52	nil	All sw. water.
Acacia, sp.	42	35	28.6	Det. as A. leprosa after germ.
leprosa, Sieber (A. reclinata).	47	7	28.6	After 2 hr. in acid.
leprosa, Sieber.	48	150	10.7	After 2 hr. in acid.
leprosa, Sieber.	51	19	21	7 remained in the soil 6 months unswollen. Of these 4 were germinable after 1 hr. in acid.
leprosa, var.	51	28	28	16 unswollen after 6 months in soil. Of these 8 proved germinable after 1 hr. in acid.
longifolia, Willd.	fresh	100	89	Des., 98 d. at 37 deg. C.
ditto	50	25	12	6 hard after 5 months in soil. Of these 3 germinated after 2 hr. in acid.
ditto	51	33	24.2	Most unswollen after soaking. These 2 hr. in acid.
longifolia, Willd. (A. sophora).	52	70	21.4	After 3½ hr. in acid.
ditto	50	14	nil	Sw. in water.
ditto	51	50	6	Sw. after 2 hr. in acid.

	Years old.	No. of Seeds.	Per cent. Germ.	
longifolia, Willd.	54	125	8	Filed to make seed swell.
ditto	54	100	4	5 min. 10 per cent. KHO, then warm water.
ditto	66	30	10	Sw. after 3 hr. in acid.
ditto	68	20	5	5 min. 10 per cent. KHO, then warm water.
lunata, Sieb.	48	8	nil	Sw. water
		25	12	Sw. after 2 hr. in acid.
ditto	50	33	nil	
melanoxylon, R. Br.	51	17	11.7	After 1 hr. in acid.
melanoxylon, R. Br., var. brevipes, A. Cunn.	55	21	nil	All sw. water.
Merralli, F. v. M.	10	50	6	Sw. after 1 hr. in acid.
Mitchelli, Benth.	57	30	nil	Imp. ripe. Sw. in water.
montana, Benth.	40	100	11	All sw. after $2\frac{1}{2}$ hr. in acid.
ditto	58	50	2	All sw. after 3 hr. in acid.
myrtifolia, Willd.	40	4	nil	All sw. water.
		35	3	Sw. after 2 hr. in acid.
ditto	51	50	20	Not all swollen until after 2 months in water at 20-25 deg. C.
ditto	54	50	12	8 hard after 5 months in soil. Of these 6 germinated after 1 hr. in acid.
ditto	55	80	5	Filed.
ditto	55	50	nil	5 min. 10 per cent. KHO, then warm water.
neriifolia, A. Cunn (var. iteaphylla).	17	100	4	Sw. after 1 hr. in acid.

	Years old.	No. of Seeds.	Per cent. Germ.	
nervosa, D. C.	30	50	4	Sw. only after 2 hr. in acid.
Oswaldi, F. v. M.	10	11	45	Sw. water.
		3	66	Sw. after 2 hr. in acid.
paucijuga, F. v. M.	57	18	nil	Swell in water.
penninervis, Sieb.	23	60	nil	All sw. water .
ditto	57	15	13.3	4 hr. in acid.
ditto	67	44	2.3	4 hr. in acid.
pentadenia, Lindl.	30	15	nil	Sw. water.
		13	15	Sw. after 1½ hr. in acid.
pycnantha, Benth.	35	100	nil	Sw. after 2 hr. in acid.
ditto	50	50	nil	
ditto	fresh	100	72	Des., 98 d. at 37 deg. C.
saligna, Wendl.	17	16	nil	In acid 1½ hr.
Senegal, Willd (var. rupestris).	51	38	5.2	2 remained hard in soil for 5 months. Of these one was germinable after 1 hr. in acid.
sentis, F. v. M.	57	10	nil	
Simsii, A. Cunn.	31	6	nil	Sw. water.
		13	23	Sw. after 2 hr. in acid.
suaveolens, Willd.	51	25	4	Sw. after 1 hr. in acid.
teretifolia, Benth.	30	7	nil	Sw. water.
		7	nil	Sw. after 1 hr. acid. Cot. of 2 living.
triptycha, F. v. M.	37	8	nil	Sw. water.
		33	nil	Sw. after 1 hr. in acid.
verniciflua, A. Cunn.	41	18	nil	18 swelled on soaking.
		82	5	2 hr. in acid.

	Years old.	No. of Seeds.	Per cent. Germ.	
vestita, Ker. Gawl.	50	14	nil	
vomeriformis, A. Cunn.	56	13	nil	All sw. water.
vypres (?) MS. of F. v. M.	55	60	3.3	1 hr. in acid. Seedlings died.
Aoaena montana, Hook.	57	30	nil	
ovina, A. Cunn.	57	100	nil	
sanguisorbae, Vahl.	54	50	nil	
Acer macrophyllum, Pursh.	14	56	nil	
ditto	15	71	nil	
ditto	24	71	nil	
saccharinum, Wangenh.	17	76	nil	
spicatum, Lam.	67	58	nil	
Achillea Millefolium, Linn.	8	100	nil	
ditto	10	150	nil	
ditto	18?		few	Peter. Supp. age in soil.
ditto	50	10	nil	
Achras australis, R. Br.	10	25	nil	
Achyranthes australis, R. Br., var. mollis	57	38	nil	
Acnida cannabina, L.	15	20	nil	A. de C.
Actaea spicata, Linn., var. rubra.	67	31	nil	
Actephila grandifolia, Baill.	16	9	nil	
Adansonia Gregorii, F. v. M.	12	28	3.6	Sw. after 6 hr. in acid.
Adenanthera pavonina, L.	8	27	15	Swelled after filing.
Adenophora communis, Fisch.	50	90	nil	
Adlumia cirrhosa, Rafin.	50	50	nil	
Adonis autumnalis, L.	50	14	nil	
Aethusa Cynapium, L.	10	130	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	20?		few	Peter. Supp. time in soil.
Cynapium, L., var. agrestis.	9	88	nil	
ditto	20?		few	Peter. Supp. age in soil.
Ageratum conyzoides, L., var. Mexicanum.	fresh		1	D. after 100 d. sea water.
Ageratum conyzoides, L., var. Mexicanum.	50	150	nil	
Agropyron pectinatum, Beauv., var. alpina.	57	65	nil	
Agropyron repens, Beauv.	57	70	nil	
ditto	1	80*	84	Duvel. Buried in soil 73 per cent.
repens, Beauv., var. brevisecta, F. v. M.	15	20	nil	A. de C.
scabrum, Beauv.	54	68	nil	
ditto	55	59	nil	
ditto	55	100	nil	
Agrostis alba, L.	55	100	nil	
canina, L.	12	200	nil	
ditto	32?		many	Peter. Supp. age in ground.
ditto	45	250	nil	
monandra, Hornem.	15	20	nil	A. de C.
Muelleri, Benth.	57	200	nil	
scabra, Willd.	54	34	nil	
scabra, Willd., var. parviflora, R. Br.	54	150	nil	
stolonifera, L.	fresh		21	Nobbe.
ditto	3		20	Nobbe.
vulgaris, With.	14	200	nil	
ditto	32?		few	Peter. Supp. age in ground.
ditto	40	150	nil	
ditto	100?		few	Peter. Supp. age in ground.

* Original percentage germination.

	Years old.	No. of Seeds.	Per cent. Germ.	
Aira caespitosa, L.	100?		few	Peter. Supp. age in ground.
caryophyllea, L.	59	35	nil	
praecox, L.	68	64	nil	
Ajuga australis, R. Br.	57	34	nil	
australis, R. Br., var. luxuriosa, F. v. M.	54	30	nil	
chamaepytis, Sch.	67	74	nil	
pyramidalis, L.	15	20	nil	A. de C.
Akania Hillii, Hook. f.	12	33	nil	
Albizzia Julibrissin, Durazz.	15	20	nil	A. de C.
Lebbek, Benth.	11	9	44.4	After scratching surface.
lophantha, Benth.	13	5	nil	Swelled in water.
		13	38.4	3 hr. in acid
ditto	17	10	nil	Swelled in water. Imp. ripe.
		43	79	In acid 4 hr.
lophantha, Benth.	50	15	33	4 hr. in acid.
saman, Benth.	13	9	nil	Sw. after filing.
arvensis, Scop.	59	61	nil	
Alchemilla alpina, L.	12	180	nil	
ditto	20?		few	Peter. Supp. time in soil.
ditto	25	160	nil	
ditto	36?		few	Peter. Supp. time in soil.
ditto	59	73	nil	
vulgaris, L.	57	100	nil	
Aleurites triloba, Forst. var. moluccana	79	54	74	Sw. in water.
		28	21	Sw. after $2\frac{1}{2}$ hr. in acid.
Alhagi camelorum, Fisch.			some	Chamisso. After 1 m. in sea water.

	Years old.	No. of Seeds.	Per cent. Germ.	
Alisma Plantago, L.	ripe		nil	Coats intact. Crocker.
ditto	ripe		98	Coats broken. Crocker.
ditto	54	200	nil	
Alkanna lutea, A. de C.	50	24	nil	
Allium angulosum, L.	25	250	nil	
ascalonicum, L.	fresh		95	Kinzel. 8 days' darkness at 20 deg. C.
ditto	fresh		7	Kinzel. 8 days' light at 20 deg. C.
Cepa, L. (Onion).	fresh	15	20	Berkoley. After 56 days, sea water.
ditto	fresh		many	D. After 82 days, cold sea water.
ditto	fresh	25	12	Berkeley. After 100 days, sea water.
ditto	fresh		75	Kinzel. 4 days' darkness at 20 deg. C.
ditto	fresh		70	Kinzel. 4 days' light at 20 deg. C.
ditto	2	100*	50	Vilmorin. Ext. limit, 7 yrs.
ditto	1	94*	88	Duvel.
ditto	1	94*	nil	Buried in soil.
Cepa, L., aegypticum	15	20	nil	A. de C.
fistulosum, L., var. (Welsh onion, white).	3	100*	50	Vilmorin. Ext. limit, 8 yrs.
fistulosum, L. (red Welsh onion).	2-3	100*	50	Vilmorin. Ext. limit, 7 yrs.
Porrum, L. (Leek).	2	100*	50	Vilmorin. Ext. limit, 6 yrs.
sphaerocephalum, L.	15	20	nil	A. de C.
Aloe saponaria, Haw.	50	54	nil	
Alopecurus geniculatus, L.	54	500	nil	
Alphitonia excelsa, Reissek.	12	50	74	Sw. water.
Alnus acuminata, H. B. and K.	50	49	nil	
cordifolia, Tenore.	18	150	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
glutinosa, Medic.	10	250	nil	
ditto	18	200	nil	
ditto	200?		some	Poisson. Supp. age in soil.
incana, Medic.	45	120	nil	
ditto	61	58	nil	
maritima, Nutt.	14	83	nil	
ditto	46	85	nil	
orientalis, Decne.	55	35	nil	
serrulata, Willd.	36	130	nil	
ditto	50	55	nil	
ditto	67	100	nil	
viridis, D. C.	43	53	nil	
ditto	44	110	nil	
ditto	48	57	nil	
Althaea hirsuta, L.	56	128	nil	All sw. water.
narbonnensis, Pourr.	15	20	nil	A. de C.
officinalis, Linn.	50	55	nil	
rosea, Cav. (Holly Hock)	9	100	33	Sw. rapidly after filing.
rosea, Chaters superb	10	250	nil	
Alyssum argenteum, Vilm.	50	42	nil	
linifolium, Steph.	51	150	nil	
micropetalum, Kit.	15	20	nil	A. de C.
rostratum, Stev.	15	20	nil	A. de C.
saxatile, L.	15	20	nil	A. de C.
Alyxia buxifolia, R. Br.	50	33	nil	
buxifolia, R. Br., var. capitellata	57	10	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
ruscifolia, R. Br.	10	25	12	
ditto	50	14	nil	
Amaranthus Blitum, L., var. prostratus	15	20	nil	A. de C.
caudatus, L.	15	20	nil	A. de C.
ditto	50	270	nil	
cernuus, Bess.	15	20	nil	A. de C.
hybridus, L.	67	108	nil	
paniculatus,, L.	15	20	nil	A. de C.
paniculatus, L., var. speciosus	15	20	nil	A. de C.
retroflexus, L.	1	95*	91	Duvel. Buried in soil 35 per cent.
retroflexus, L., var. curvifolius.	15	20	nil	A. de C.
Ambrosia artemisiaefolia, L.	1	58.5*	42.5	Duvel. Buried deeply, 41 per cent.
ditto	70	25	nil	
trifida, L.	1	29*	52	Duvel. Buried in soil, 6 per cent.
Ammania latifolia	15	20	nil	A. de C.
multiflora, Roxb., var. australasica.	57	1100	nil	
senegalensis, Lam , var. diffusa.	15	20	nil	A. de C.
Amorpha fruticosa, L.	15	20	nil	A. de C.
fruticosa, L., var. elatior.	50	15	nil	
fruticosa, L., var. glabra.	50	22	nil	
Amphibromus Neesii, Steud.	57	200	nil	
Anacardium occidentale, L.			some	Linnaeus. After a month in sea water.
Anagallis arvensis, L.	12	200	nil	
ditto	18?		few	Peter. Supp. age in soil.
ditto	18	150	nil	
ditto	20?		few	Peter. Supp. time in soil.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	36?		few	Peter. Supp. time in soil.
ditto	40	128	nil	
ditto	45?		few	Peter. Supp. time in soil.
ditto	62	180	nil	
var. carnea.	15	20	nil	A. de C.
var. coerulea	50	580	nil	
var. latifolia.	15	20	nil	A. de C.
linifolia, L., var. grandiflora.	10	250	nil	
Anaphalis margaritacea, Bth. and Hook. f.	62	500	nil	
Anchusa capensis, Thunb.	50	45	nil	
Andromeda Polifolia, L.	58	53	nil	
Andropogon australis, Spr.	55	96	nil	
bombycinus, R. Br.	55	88	nil	
saccharoides, Sw., var. laguroides.	15	20	nil	A. de C.
sericeus, R. Br., var. chrysantheros.	57	50	nil	
Androsace maxima, L.	15	20	nil	A. de C.
Anemone nemorosa, L.	1	100	nil	Dried in des., 10-20 deg. C.
ditto	2	100	3	Air dried.
ditto	3	100	nil	Air dried.
virginiana, L.	67	42	nil	
Anguillaria dioica, R. Br.	40	83	nil	
Anigozanthos fuliginosa, Hook.	50	40	nil	
Manglesii, D. Don.	10	500	nil	
ditto	8	500	nil	
Anomatheca cruenta, Lindl.			some	Berkeley. After 1 month in sea water.

	Years old.	No. of Seeds.	Per cent. Germ.	
Anthistiria ciliata, L. f.	37	33	nil	
imberbis, Retz., var. australis.	55	56	nil	
Antholyza aethiopica, L.	50	16	nil	
aethiopica, L., var. flavescens	50	28	nil	
Anthoxanthum odoratum, L.	10	100	nil	
ditto	15	250	nil	
ditto	32?		few	Peter. Supp. age in soil.
Anthriscus Cerefolium, Hoffm. (Chervil).	2-3	100*	50	Vilmorin. Ext. limit, 6 yrs.
sylvestris, Hoffm.	55	60	nil	
vulgaris, Bernh.	15	20	nil	A. de C.
ditto	55	42	nil	
ditto	18	200	nil	
ditto	20?		few	Peter. Supp. time buried.
Anthyllis tetraphylla, L.	50	40	nil	
Vulneraria, L.	15	20	nil	A. de C.
Antigonon leptopus, Hook and Arn.	8	22	9	After prolonged soaking.
Antirrhinum calycinum, Russ.	50	150	nil	
glandulosum, Lindl.	10?		some	Meehan. Supp. age in soil.
ditto	12	250	nil	
majus, L.	50	241	nil	
Apera Spica-Venti, Beauv.	60	1150	nil	
Apium graveolens, L. (Celery).			some	Thuret. After 13 mon. fl. on sea water.
ditto			many	D. After 85 days in sea water.
ditto			2	D. After 137 days in sea water.
ditto	fresh	100*	95	Kinzel. In light at 20 deg. C.
ditto	fresh	100*	nil	Kinzel. Darkness at 20 deg. C.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	1	88*	83.5	Duvel. Buried deeply, 64 per cent.
ditto	8	100*	50	Vilmorin. Ext. limit, 10 yrs.
graveolens (Celery, red).	10	500	nil	
graveolens (Celery, white).	10	250	nil	
ditto	10	1000	nil	
ditto	fresh		some	D. 90 days in sea water.
inundatum, Reichb. f.	55	32	nil	
prostratum, Labill.	57	110	nil	
ditto	50	153	nil	
ditto	54	80	nil	
Aquilegia canadensis, L.	15	20	nil	A. de C.
vulgaris, L.	50	44	nil	
Arachis hypogaea, L. (Pea-nut).	1	100*	50	Vilmorin. Ext. limit, 1 year.
hypogaea, L.	1	9	89	
ditto	2	20	35	
ditto	8	45	nil	
ditto	50	14	nil	
Arabis auriculata, Lam.	15	20	nil	A. de C.
hirsuta, Scop.	59	100	nil	
hirsuta, Scop., var. sagittata.	15	20	nil	A. de C.
perfoliata, Lam.	55	2000	nil	
verna, R. Br.	50	480	nil	
Aralia racemosa, L.	67	28	nil	
Araliaceæ.	25		nil	Becquerel.
Araucaria Cunninghamii, Sweet.	14	30	nil	

	Years old.	No. of Seeds.	Per cent Germ.	
Archangelica officinalis, Hoffm.	1 to 2	100*	50	Vilmorin. Ext. limit, 3 yrs.
Archeria hirtella, Hook. f.	57	150	nil	
Archontophoenix Alexandrae, W. and Dr.	8	16	nil	
Cunninghami, Wendl. and Drude	14	22	nil	
Arctium Lappa L.	1	100*	96	Duvel. Buried in soil 73 per cent.
majus, Bernh. (Giant Burdock)	5	100*	50	Vilmorin. Ext. limit, 6 yrs.
Arctotis acaulis L., var. grandiflora, Ait.	10	500	nil	
Arenaria peploides, L.	fresh		some	Guppy. After months on sea water.
serpyllifolia, L.	15	300	nil	
ditto	36?		few	Peter. Supp. time in soil.
ditto	45?		few	Peter. Supp. time buried.
ditto	59	80	nil	
ditto	67	36	nil	
stricta, Michx.	67	53	nil	
verna, L.	62	32	nil	
ditto	62	85	nil	
Argemone mexicana, L.			many	D. After 50 days in sea water.
ditto			few	D. After 70 days in sea water.
ditto	50	110	nil	
mexicana, L., var. alba.	15	20	nil	A. de C.
Argophyllum Nullumense, R. T. Baker	10	3000	nil	
Argyrolobium Linnaeanum, Walp.	50	100	nil	
Aristotelia racemosa, Hook. f.	57	100	nil	
Armeria elongata, Hoffm., var. vulgaris.	50	46	nil	
plantaginea, Willd.	50	42	nil	
Artanema fimbriatum, D. Don.	50	44	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Artemisia Abrotanum, L.	15	20	nil	A. de C.
Absinthium, L. (Worm-wood).	4	100*	50	Vilmorin. Ext. limit, 6 yrs.
annua, L.	15	20	nil	A. de C.
biennis, Willd.	67	2000	nil	
camphorata, Vill.	15	20	nil	A. de C.
maritima, L.	56	500	nil	
vallesiana, Lam.	15	20	nil	A. de C.
vulgaris, L. (Mugwort, Mother-wort).	3	100*	50	Vilmorin. Ext. limit, 5 yrs.
Arthropodium laxum, Sieb.	47	25	nil	
Arum maculatum, L.			some	Berkeley. After 1 month in sea water.
Asclepias purpurascens, L., var. amoena.	15	20	nil	A. de C.
syriaca, L., var. Cornuti, Decne.			some	Martius. After 45 days floating on sea water.
Ascyrum Hypericoides, L.	1	1.5*	nil	Duvel. Buried in soil 1 per cent.
Aspalathus astroites, L.	50	6	nil	
sericea, L.	50	17	nil	
Asparagus, sp.			some	D. After 85 days in sea water.
officinalis, L. (Asparagus).	1	80*	69	Duvel. Buried in soil; all died.
officinalis, L.	5	100*	50	Vilmorin. Ext. limit, 8 yrs.
Asperugo procumbens, L.	15	20	nil	A. de C.
ditto	50	42	nil	
Asperula arvensis, L.	15	20	nil	A. de C.
cynanchica, L.	15	20	nil	A. de C.
Gunnii, J. Hook.	54	16	nil	
orientalis, Boiss., var. azurea.	13	40	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
scoparia, J. Hook.	54	15	nil	
Asphodeline liburnica, Reichb.	50	12	nil	
lutea, Reichb.			some	Berkeley. After 30 days in sea water.
Asphodelus cerasiferus, J. Gay.			some	Martins. After 45 days in sea water.
fistulosus, L.	50	48	nil	
ramosus, L.	1 to 3 m'ths		90	Kinzel. 14 days' darkness at 20 deg. C.
ditto			42	Kinzel. 14 days' light at 20 deg. C.
ditto			90	Kinzel. 14 days' light at 14 deg. C.
Aster alpicola, F. v. M.	57	250	nil	
(Eurybia) asterotricha, F. v. M.	57	250	nil	
corymbosus, Ait.	67	250	nil	
patens, Ait.	67	150	nil	
tenuifolius, L.	67	250	nil	
Asterolasia pleurandroides, F. v. M.	57	28	nil	
Astragalus alpinus, L.	15	20	nil	A. de C.
Antiselli, A. Gray.	18	64	3.3	All sw. readily.
boeticus, L.	50	16	nil	
brachyceras, Ledeb.	37		some	Becquerel.
Cicer, L.	50	20	nil	
edulis, Dur.	22	18	nil	
falcatus, Lam.	50	11	nil	
galegiformis, L.	50	18	nil	
glycyphylloides, D. C.	50	26	nil	
ditto	51	26	7.7	After long soaking.
hamosus, L. (Worms).	3	100*	50	Vilmorin. Ext. limit, 8 yrs.
ditto	50	44	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	83	350	nil	
Tragacantha, L.	50	56	nil	
Astroloma humifusum, R. Br.	54	20	nil	
Astrotricha latifolia, Benth.	57	100	nil	
ledifolia, D. C., var. asperifolia.	54	125	nil	
Atriplex cinerea, Poir.	55	250	nil	
hastata, L., var. deltoidea, Bab.	59	200	nil	
hortensis, L. garden orache)			many	D. After 100 days in sea water.
ditto	6	100*	50	Vilmorin. Ext. limit, 7 yrs.
ditto	15	20	nil	A. de C.
ditto	50	22	nil	
ditto	300		nil	Nobbe. Old Herb.
nummularia, Lindl.	50	26	nil	
patula, L.	18	1000	nil	
ditto	22?		few	Peter. Supp. age in soil.
ditto	59	250	nil	
rhagodioides, F. v. M.	55	100	nil	
rosea, L.	15	20	nil	A. de C.
spongiosa, F. v. M.	57	28	nil	
tatarica, L.	15	20	nil	A. de C.
Atropa Belladonna, L.	14	200	nil	
ditto	20?		few	Peter. Supp. time in soil.
ditto	50	100	nil	
ditto	55	200	nil	
ditto	100?		few	Peter. Supp. age in ground.
Avena fatua, L.	1	70.5	91.5	Duvel. Buried in soil, 18 per cent.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	59	43	nil	
sativa, L. (Oats)	fresh		many	D.C. Cooled 100 t. to about 50 deg. C.
ditto			many	D. After 85 days in sea water.
ditto			few	D. After 100 days in sea water.
ditto			partial	D. After 120 days in sea water.
ditto	many		many	Salter. In mud, under sea water.
ditto	1	70*	91.5	Duvel. Buried in soil; all died.
ditto	2		most	Rohde.
ditto	6	100	46	Dried at 12-15 deg. C. } Seeds from same sample.
ditto	6	100	93	Dried at 15-19 deg. C. } Seeds from same sample.
ditto	6	100	97	Dried at 28 deg. C. } Seeds from same sample.
ditto	10	100	84	Haberlandt.
ditto	1	100*	98	Burgerstein. Dry in air.
ditto	4	100*	95	" "
ditto	7	100*	94	" "
ditto	10	100*	93	" "
Avicennia, sp.	1	100	nil	Dried in air.
Axyris amaranthoides, L.	1		nil	Duvel. If buried, also died.
Azorella cuneifolia, F. v. M.	57	35	nil	
Babiana plicata, Ker. Gawl.			some	Berkeley. After 1 month in sea water.
Baeckea densifolia, Sm.	57	30	nil	
diffusa, Sieber.	57	350	nil	
Gunniana, Sieber.	57	250	nil	
virgata, Andr.	57	80	nil	
ditto	57	150	nil	
Bambusa oliveriana, Gamble.	13	46	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
regia, Thoms.	14	12	nil	
Banksia collina, R. Br., var. prionophylla, F. v. M.	50	27	nil	
collina, R. Br., var. Cunninghamii, Sieber.	50	22	nil	
integrifolia, Linn. f.	50	14	nil	
verticillata, R. Br.	57	20	nil	
Baptisia australis, R. Br.	15	20	nil	A. de C.
tinctoria, R. Br.	67	55	nil	All sw. in water.
Barbarea praecox, R. Br.	3	100*	50	Vilmorin. Ext. limit, 5 yrs.
vulgaris, R. Br.	15	20	nil	A. de C.
ditto	55	100	nil	
ditto	57	136	nil	
Barklya syringifolia, F. v. M.	12	50	nil	2 hr. in acid produced rapid swelling.
ditto	8	20	40	ditto
Barringtonia Butonica, Forst., var. speciosa, L.			some	Moseley. Many months floating on sea water.
Bartsia Odontites, Huds.	15	20	nil	A. de C.
viscosa, L.	55	2000	nil	
ditto	60	250	nil	
Basella rubra, L., var. alba, L. (Common white Basella).	5	100*	50	Vilmorin. Ext. limit, 6 yrs.
ditto	10	40	10	
ditto	15	20	nil	A. de C.
Bauhinia, sp.	10	8	100	
purpurea, L.	8	16	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
variegata, L., var. alba, Buch. Ham.	8	30	nil	
Bedfordia salicina, D. C.	50	240	nil	
Benincasa cerifera, Savi. (Wax-Gourd).	10	100*	50	Vilmorin.
cerifera, Savi.	12	100	nil	
Berberis vulgaris, L., var. crataegina.	50	20	nil	
vulgaris, L., var. Iberica, Sweet.	50	16	nil	
vulgaris, L. dulcis.	50	12	nil	
ditto	50	16	nil	
Beta vulgaris, L., var. maritima, L.	15	20	nil	A. de C.
vulgaris, L. (Beet).			some	Martius. After 93 days floating on sea water.
ditto			some	Thuret. After 13 months floating on sea water.
ditto			many	Berkeley. After 100 days in sea water.
ditto	1	153*	90.5	Duvel. Buried in soil, 20 per cent.
ditto	6	100*	50	Vilmorin. Ext. limit, 10 years.
ditto	2	10 x 2	70	Rom. Dried in air.
ditto	2	10 x 2	5	Rom. 1 yr. in vacuo.
ditto	2	10 x 2	16-17	Rom. 1 yr. in NH_3 or ether vapour.
ditto	2	10 x 2	12-14	Rom. 1 yr. in O, CO or chloroform.
ditto	2	10 x 2	50	Rom. 1 yr. in aqueous vapour.
ditto	2	10 x 2	95	Rom. 1 yr. in sulph. hydrogen.
ditto	12	102	3	After 6 weeks, moist and warm.
			1	After remainder ½ hr. in acid.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	14	100	2	½ hr. in acid.
ditto	14	120	nil	After 10 weeks, moist and warm.
ditto	14	110	nil	½ hr. in acid.
ditto	14	108	nil	After 10 weeks, moist and warm.
Betula alba, L., var. glauca, Wender.	45	120	nil	
alba, L., var. japonica, Siebold.	46	85	nil	
alba, L., var. pubescens, Ehrh.	10	140	nil	
ditto	18?		few	Peter. Supp. age in soil.
ditto	20		some	Peter. Supp. time buried.
ditto	32?		few	Peter. Supp. age in ground.
ditto	35	150	nil	
ditto	45?		few	Peter. Supp. time buried.
ditto	50	120	nil	
ditto	100?		few	Peter. Supp. age in soil.
alba, L., var. verrucosa, Ehrh.	10	125	nil	
ditto	32?		few	Peter. Supp. age in ground.
ditto	50	150	nil	
ditto	100?		few	Peter. Supp. age in ground.
Beyera viscosa, Miq., var. oblongifolia	57	20	nil	
Bidens cernua, L.	15	20	nil	A. de C.
frondosa, L.	1	75*	52	Duvel. Buried in soil, 36 per cent.
pilosa, L.	50	215	nil	
ditto	50	26	nil	
tripartita, L.	57	100	nil	
Bifora dicocca, Hoffm.	15	20	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Billardiera cymosa, F. v. M.	50	55	nil	
longiflora, Labill.	50	42	nil	
ditto	54	100	nil	
ditto	57	40	nil	
scandens, Sm.	50	42	nil	
Biscutella auriculata, L., var. erigerifolia	50	16	nil	
ditto	50	46	nil	
didyma, L., var. apula, L.	15	20	nil	A. de C.
Biserrula Pelecinus, L.	12	80	nil	
Blennodia lasiocarpa, F. v. M.	57	60	nil	
nasturtioides, Benth.	22	120	nil	
ditto	57	200	nil	
ditto	12	120	nil	
ditto	57	60	nil	
ditto	57	32	nil	
trisecta, Benth.	57	230	nil	
Boehmeria nivea, Gaud.	1		nil	Duvel. If buried, also died.
Boraginaceae	25		nil	Becquerel.
Borago officinalis, L. (Borage).			few	D. After 24 days in sea water.
ditto			nil	D. After 42 days in sea water.
ditto	8	100*	50	Vilmorin. Ext. limit, 10 years.
Boronia dentigera, F. v. M.	54	61	nil	
coerulescens, F. v. M.	57	27	nil	
parviflora, Sm., var. pilonema, Lab.	54	35	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Bossiaea cinerea, R. Br.	55	35	nil	
foliosa, A. Cunn., var. distichoclada, F. v. M.	57	50	nil	
ensata, Sieb.	10	30	23.3	1 hr. in acid.
ditto	57	16	nil	
heterophylla, Vent.	15	20	50	Sw. in water.
		30	80	After 2 hr. in acid.
Stephensoni, F. v. M.	12	50	44	5 sw. in water, rest after ½ hr. in acid.
sulcata, Meissn.	57	16	nil	
Brachychiton populneum, R. Br.	57	6	nil	
Brassica alba, Boiss.	fresh		86	Nobbe.
ditto	2		76	Nobbe.
ditto	47	250	nil	
ditto	40	1000	nil	
ditto	44	150	nil	
ditto	77	115	nil	
alba, Boiss., var. flexuosa.	15	20	nil	A. de C.
alba, Boiss (White Mustard).	4	100*	50	Vilmorin. Ext. limit, 10 years.
ditto	10	200	nil	
campestris, L. (Swede).	5	100*	50	Vilmorin. Ext. limit, 10 yrs.
campestris, L.	12		5	Nobbe.
ditto	1	96*	80	Duvel. Buried deeply, 0.5 per cent.
campestris, L. (Rape).	10	250	nil	
campestris, L., var. chinensis, L.	5	100*	50	Vilmorin. Ext. limit, 9 yrs.

	Years old.	No. of Seeds.	Per cent. Germ.	
campestris, L., var. Rapa, L.	fresh		77	Nobbe.
campestris, L.	2		59	Nobbe.
campestris, L., var. Napus, L. (Rutabaga).	12		27	Nobbe.
ditto	fresh	100	43	Des. 42 days at 37 deg. C.
campestris, L., var. Rapa, L. (Yellow Turnip).			some	Berkeley. After 30 days in sea water.
campestris, L., Wild var.			1	D. After 133 days in sea water.
ditto			many	D. After 150 days in sea water.
ditto	5	100*	50	Vilmorin. Ext. limit, 10 years.
ditto	15	20	nil	A. de C.
ditto	12		nil	Nobbe.
dissecta, Boiss.	15	20	nil	A. de C.
fruticulosa, Cyril.	56	150	nil	
incana, Tenore.	15	20	nil	A. de C.
juncea, Cass. (Chinese large-leaved mustard)	4	100*	50	Vilmorin. Ext. limit, 8 yrs.
nigra, Koch. (Mustard).	1	15*	13	Duvel. Buried deeply, 14 per cent.
ditto	2	10	60	Rom. Dried in air.
ditto	2	10	60	Rom. 1 yr. in acid.
ditto	2	10	10	Rom. 1 yr. in N, CO, or in vacuo.
ditto	2	10	10	Rom. 1 yr. in aqueous vapour.
ditto	2	10	80	Rom. 1 yr. in ether or chloroform.
ditto	2	10	60	Rom. 1 yr. in hydrogen.
nigra, Koch (Black Mustard)	4	100*	50	Vilmorin. Ext. limit, 10 years.

	Years old.	No. of Seeds.	Per cent. Germ.	
oleracea, L.	1	85.5*	82	Duvel. Buried in soil; all died.
oleracea, L. (Cabbage).	5	100*	50	Vilmorin. Ext. limit, 10 yrs.
oleracea, L., acephala, D. C. (Borecole).	5	100*	50	Vilmorin. Ext. limit, 10 yrs.
oleracea, L., var. bullatagemmifera (Brussels Sprouts)	10	250	nil	
oleracea, L. (Colza).	12		30	Nobbe.
oleracea, L., botrytis, D. C. (Cauliflower)	5	100*	50	Vilmorin. Ext. limit, 10 yrs.
oleracea (Kohlrabi).	5	100*	50	Vilmorin. Ext. limit, 10 yrs.
oleracea, L. (Broccoli).			some	D. After 11 days in sea water.
ditto			nil	D. After 22 days in sea water.
oleracea, L. (Early Cauliflower).		100	5	D. After 22 days in sea water.
ditto			many	D. After 36 days in sea water.
oleracea, L. (Cattels Cabbage).			nil	D. After 50 days in sea water.
oleracea, L., Wild var.			many	D. After 150 days in sea water.
ditto			1	D. After 133 days in sea water.
Sinapistrum, Boiss.	42	120	nil	
ditto	8		some	Poisson.
ditto	18	220	nil	
ditto	20?		some	Peter. Supp. time buried.
ditto	25	100	nil	
ditto	55	93	nil	
Sinapoides, Roth.	57	120	nil	
ditto	15	20	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Bridelia exaltata, F. v. M.	12	30	nil	
Briza maxima, L.	50	410	nil	
ditto	55	100	nil	
minor, L.	55	100	nil	
Brodiaea congesta, Sm.	50	22	nil	
Bromus arenarius, Lab.	57	100	nil	
erectus, Huds., var. stenophyllus, Link.	15	20	nil	A. de C.
mollis, L.	10	250	nil	
ditto	18?		some	Peter. Supp. age in soil.
racemosus, L.	1	100*	98	Duvel. Buried in soil; all died.
ditto	15	20	nil	A. de C.
secalinus, L.	1	88*	77	Duvel. Buried in soil; all died.
ditto	5		nil	Dr. Beal. Buried in soil.
sterilis, L.	57	100	nil	
unioloides, H. B. and K.	12		nil	Nobbe.
Bruguiera Rheedii, Blume.			some	Hemsley. Many m. floating on sea water.
Bulbine annua, Willd.			some	Berkeley. After 30 days in sea water.
ditto	50	74	nil	
asphodeloides, Spreng.	50	84	nil	
bulbosa, Haw.	57	20	nil	
semibarbata, Haw.	50	42	nil	
Bunias orientalis, L. (Hill Mustard).	3	100*	50	Vilmorin. Ext. limit, 6 yrs.
ditto	15	20	nil	A. de C.
Bupleurum baldense, Host., var. tenuifolium, Pourr.	28	150	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
junceum, L.	15	20	nil	A. de C.
Odontites, L.	50	35	nil	
semicompositum, L.	15	20	nil	A. de C.
Buxus sempervirens, L.	55	35	nil	
Cadellia monostylis, Benth.	15	45	nil	
Caesalpinia Bonduc, Roxb.	fresh		some	Guppy. Filed after 1 yr. on sea water.
Bonducella, Fleming	fresh		some	Guppy. Filed after 1 yr. on sea water.
ditto	9	3	nil	Embryo loose in shell; outer grey layer impermeable; inner, brown and permeable.
ditto	15	24	20.1	Sw. after 24 hr. in acid. Cotyledon of another partly living.
Minax, Hance., var. burmannica	10	21	nil	
sp. (Guilandina).			some	D. After months in sea water.
Cakile maritima, Scop., var. americana, Nutt.	67	82	nil	
maritima, Scop.			some	Mart. After 45 days floating on sea water.
ditto	56	150	nil	
Calamintha Acinos, Man.	25	300	nil	
ditto	36		few	Peter. Supp. time in soil.
ditto	45?		few	Peter. Supp. time buried.
ditto	57	140	nil	
ditto	300		nil	Nobbe. Old Herb.
Clinopodium, Benth.	1	100	82	
ditto	2	100	68	

	Years old.	No. of Seeds.	Per cent. Germ.	
officinalis, Moench.	60	60	nil	
Calandrinia calyptrata, J. Hook.	57	300	nil	
discolor, Schrad., var, speciosa, Lehm.	57	600	nil	
pygmaea, F. v. M.	50	130	nil	
Calendula officinalis, L.	15	20	nil	A. de C.
ditto	50	81	nil	
suffruticosa, Vahl.	15	20	nil	A. de C.
Callistemon coccineus, F. v. M., var. rugulosus, Miq.	50	250	nil	
lanceolatus, Sweet.	16	2000	75	
rigidus, R. Br.	22	1000	2.8	
ditto	5	2000	18.6	
ditto	50	3800	nil	
salignus, D. C.	37	250	nil	
Callistephus hortensis, Cass.			some	D. After 28 days in sea water.
ditto			nil	D. After 54 days in sea water.
Callitriche autumnalis, L.	60	50	nil	
hamulata, Kuetz., var. pedunculata, D. C.	55	51	nil	
Callitris calcarata, R. Br., var. pyramidalis, Sw.	54	25	nil	
Muelleri, Benth.	15	75	nil	
rhomboidea, Mirb.	50	31	nil	

	Years old.	No. of Seeds.	Per cent. Germ.		
robusta, R. Br.	50	22	nil		
robusta, R. Br., var. Preissi, Miq.	57	30	nil		
robusta, R. Br, var. verrucosa.	47	30	nil		
Calocephalus Brownii, Cass.	50	140	nil		
Calochilus campestris, R. Br.	57	5000	nil		
Calophaca wolgarica, Fisch.	50	11	nil		
Calophyllum Inophyllum, L.			some	Hemsley.	Many months floating on sea water.
Calostrophus elongatus, F. v. M.	37	20	nil	Filed.	
Calothamnus quadrifidus, Ait.	50	249	nil		
Calotis anthemoides, F. v. M.	50	450	nil		
Calystegia marginata, R. Br.	57	60	nil		
Calythrix tetragona, Labill.	57	120	nil		
tetragona, Labill., var. scabra, D.C.	50	42	nil		
Camelina sativa, Crantz.	15	20	nil	A. de C.	
sativa, Crantz, var. dentata.	57	120	nil		
Campanula laciniata, L.			some	Thuret.	After 13 months floating on sea water.
latifolia, L.	55	1000	nil		
medium, L.	15	20	nil	A. de C.	
ditto	50	370	nil		
patula, L.	55	5000	nil		
pyramidalis, L.	15	20	nil	A. de C.	
Rapunculus, L. (Rampion).	4	100*	50	Vilmorin	Ext. limit, 8 yrs.
rapunculoides, L.	50	180	nil		

	Years old.	No. of Seeds.	Per cent. Germ.	
rotundifolia, L.	15	160	nil	
ditto	20?		few	Peter. Supp. time in soil.
sibirica, L.	15	20	nil	A. de C.
Trachelium, L.	100?		few	Peter. Supp. time in soil.
Canavalia ensiformis, D. C.	10	30	nil	
ensiformis, D. C., var. gladiata, D. C.	10	6	100	One required filing, rest sw. without.
ensiformis, D. C., var. brasiliensis.	15	20	5 to 15	A. de C.
obtusifolia, D. C.	16	12	50	After 2 hr. in acid.
ditto	60	13	30.7	All sw. without filing.
Canna gigantea, Desf.			some	Mart. After 93 days.
indica, L.			few	D. After 50 days in sea water.
ditto	50	16	nil	
Cannabis sativa, L. (Hemp).	fresh	100	52	Des. 7 days at 37 deg. C.
ditto		100	35	Des. 10 days at 37 deg. C.
ditto		100	7	Des. 14 days at 37 deg. C.
ditto	1		nil	Duvel. If buried, died.
ditto	fresh	100	87	Air dried to 9 per cent. water.
ditto	fresh	100	47	7 days des. at 37 deg. C., to 1.43 per cent. water.
ditto	fresh		nil	45 days des. at 37 deg. C., to 0.64 per cent. water.
ditto	fresh	100	94	35 days in dry H and N.
ditto	fresh	100*	93	After 14 days ster. oxygenless water.
ditto	fresh	100*	11	70 days ster. oxygenless water.
ditto	fresh	100*	9	98 days ster. oxygenless water
ditto	fresh	100*	nil	Des. 15 days at 37 deg. C.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	fresh	100*	nil	Des. 1 day at 37 deg. C.
ditto	fresh	100*	nil	Des. 1 day at 50 deg. C.
ditto	fresh	100*	60	10 days in oxygenless water.
ditto	fresh	100*	17	28 days in oxygenless water.
ditto	fresh	100*	nil	56 days in oxygen.
ditto	fresh	100*	nil	1 day in aqueous $Hg\ Cl_2$
ditto	12		nil	Nobbe.
Capparis Mitchellii, Lindl.	57	25	nil	
nobilis, F. v. M.	10	45	7	6 weeks after filing.
spinosa, L., var. aculeata, Steud.	50	350	nil	
Caprifoliaceae.	25		nil	Becquerel.
Capsella antipoda, F. v. M.	47	130	nil	
Bursa-pastoris, Medic. Pfl.	1		nil	Duvel. If buried, all died.
ditto	3	80	nil	
ditto	5	120	nil	
ditto	20?		few	Peter. Supp. time in soil.
ditto	51	1000	nil	
ditto	59	76	nil	
procumbens, Fries., var. elliptica.	57	80	nil	
Capsicum annuum, L. (Capsicum).	1	96*	80	Duvel. Buried deeply, 0.5 per cent.
ditto		56	53	Berkeley. After 137 days in sea water.
ditto	4	100*	50	Vilmorin. Ext. limit, 7 yrs.
frutescens, L.	10	80	nil	
Caragana microphylla, Lam., var. altagana, Poir.	50	16	nil	
pygmaea, D. C.	50	11	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	50	15	nil	
Carbenia benedicta, Adans.	50	8	nil	
Cardamine dictyosperma, Hook.	54	120	nil	
hirsuta, L.	59	95	nil	
hirsuta, L., var. debilis, Banks and	54	58	nil	
Sol.	59	43	nil	
impatiens, L.				
laciniata, F. v. M.	57	50	nil	
pratensis, L. (Cuckoo-flower).	4	100*	50	Vilmorin.
stylosa, D. C.	54	113	nil	
tenuifolia, Hook.	54	87	nil	
Cardiospermum Halicacabum, L., var. Corindum, L.	15	20	nil	A. de C.
Carduus seminudus, Bieb.	50	38	nil	
pycnocephalus, L., var. tenuiflorus, Curt.	55	120	nil	
Carex binervis, Sm.	57	43	nil	
ditto	50	41	nil	
canescens, L.	58	41	nil	
canescens, L., var. curta, Good.	68	320	nil	
capillaris, L.	61	80	nil	
cephalotes, F. v. M.	50	100	nil	
cyperoides, Murr.	30		some	Poisson. In water.
ditto	72	400	nil	
ditto	70	250	nil	
ditto	65	1200	nil	

	Years old.	No. of Seeds.	Per cent. Germ.		
depauperata, Good.	58	50	nil		
distans, L.	58	15	nil		
divisa, Huds.	55	48	nil		
echinata, Murr., var. stellulata, Good.	67	55	nil		
extensa, L.	57	110	nil		
ditto	61	59	nil		
flava, L.	55	80	nil		
fulva, Good.	57	62	nil		
glauca, Scop.	15	300	nil		
ditto	32?		few	Peter.	Supp. age in ground.
ditto	45?		many	Peter.	Supp. time buried.
ditto	50	450	nil		
granularis, Muhl.	67	100	nil		
grisea, Viv., var. anceps, Willd.	67	120	nil		
Gunniana, Boott.	57	100	nil		
hirta, L.	59	73	nil		
muricata, L.	12	280	nil		
ditto	22	340	nil		
ditto	32?		few	Peter.	Supp. age in soil.
ditto	35?		few	Peter.	Supp. age in soil.
ditto	50	120	nil		
ditto	100?		some	Peter.	Supp. age in soil.
ditto	100?		few	Peter.	Supp. age in soil.
pallescens, L.	15	88	nil		
ditto	57	54	nil		

	Years old.	No. of Seeds.	Per cent. Germ.		
ditto	100?		few	Peter.	Supp. age in soil.
panicea, L.	46	185	nil		
ditto	65	54	nil		
ditto	67	48	nil		
ditto	69	62	nil		
ditto	72	59	nil		
paniculata, L.	50	150	nil		
ditto	80	1500	nil		
paradoxa, Willd.	34	68	nil		
ditto	57	80	nil		
remota, L.	18	240	nil		
ditto	25	130	nil		
ditto	100?		some	Peter.	Supp. age in ground.
sphaerostachya, Dewey.	60	100	nil		
ditto	55	43	nil		
sylvatica, Huds.	15	320	nil		
ditto	32?		few	Peter.	Supp. age in ground.
ditto	45?		few	Peter.	Supp. time buried.
ditto	55	53	nil		
ditto	100?		few	Peter.	Supp. age in soil.
pilulifera, L.	55	127	nil		
ditto	58	41	nil		
polyantha, Franch and Savi.	50	150	nil		
Pseudo-cyperus, L.	50	160	nil		
ditto	57	200	nil		
tomentosa, L.	60	52	nil		

	Years old.	No. of Seeds.	Per cent. Germ.	
vulpina, L.	55	100	nil	
Carpinus americana, Michx.	67	23	nil	
Betulus, L.	50	16	nil	
Carthamus tinctorius, L.	12		nil	Nobbe.
ditto	50	56	nil	
Carum Carvi, L. (Common Caraway)	3	100*	50	Vilmorin. Ext. limit, 4 yrs.
Petroselinum, Benth. and Hook. (Parsley).	fresh	100	42	1 h. at 100 deg. C., dry.
ditto	3	100*	50	Vilmorin. Ext. limit, 9 yrs.
ditto	55	61	nil	
segetum, Benth. and Hook. f.	55	100	nil	
Caryophyllaceae.	25		nil	Becquerel.
Cassia artemisioides, Gaud.	47	30	nil	All sw. water.
australis, Sims.	10	80	45	8 sw. on soaking, 1 germ. After 4 hr. in acid, rest sw., and 35 germ.
bicapsularis, L.	15	60	3.3	Sw. in water.
		14	14.3	Rest after 2 hr. in acid.
ditto	86		some	Becquerel.
Brewsterii, F. v. M.	19	20	90	Sw. only after 2 hr. in acid.
eremophila, A. Cunn.	10	26	nil	Sw. in water.
ditto	10	4	25	After 1½ hr. in acid.
ditto	50	24	nil	
var. platypoda, R. Br.	57	17	nil	Sw. in water.
Fistula, L.			some	Linnaeus. 1 yr. floating on sea water.
laevigata, Willd.	16	100	26	In acid 3 hr.
ditto	23	2	nil	Sw. water.
		150	nil	Sw. after ¾ hr. in acid.

	Years old.	No. of Seeds.	Per cent. Germ.	
marylandica, L.	1	14.5*	98	Duvel. Buried in soil, 5 per cent.
occidentalis, L.	50	35	nil	
pistaciaefolia, H. B. and K.	8	15	33	5 out of the 8 unswollen after 14 days in water, swelled and germ. after sand-papering.
pleurocarpa, F. v. M.	15	110	46	Sw. water.
Sophera, L.	27	125	4	All sw. water.
tomentosa, L. f.	50	22	nil	
Tora, L.	9	100	9	All sw. without filing.
Cassinia aculeata, R. Br.	54	250	nil	
arcuata, R. Br.	47	100	nil	
laevis, R. Br.	54	110	nil	
longifolia, R. Br.	47	100	nil	
spectabilis, R. Br.	54	250	nil	
Cassytha glabella, R. Br.	55	28	nil	
melantha, R. Br.	50	20	nil	
ditto	54	6	nil	Sw. after filing.
Castanospermum australe, A. Cunn.	18	20	nil	1 showed signs of life, but none germ.
ditto	25	8	nil	
Casuarina, sp.	57	50	nil	
Decaisneana, F. v. M.	14	14	nil	
quadrivalvis, Labill.	50	65	nil	
stricta, Ait.	50	14	nil	
suberosa, Otto.	12	100	62	
Caucalis nodosa, Scop.	55	43	nil	
Ceanothus americanus, L.	15	20	nil	A. de C.

	Years old.	No. of Seeds.	Per cent. Germ.	
Cedrela Toona, Roxb., var. Australis, F. v. M.	16	53	nil	
Cedronella triphylla, Moench.	50	110	nil	
Cedrus Libani, Barrel.	6	120	nil	
var. Deodara, Loud.	6	200	nil	
Celosia argentea, L.	15	20	nil	A. de C.
cristata, L.	15	20	nil	A. de C.
Celsia cretica, L. f.	57	250	nil	
Celtis occidentalis, L.	67	90	nil	
Cenia turbinata, Pers.			some	Berkeley. After 30 days in sea water.
Centaurea aspera, L., var. Isnardi, L.	50	18	nil	
australis, Bth. and Hook.	57	100	nil	
atropurpurea, Waldst. and Kit.	15	20	nil	A. de C.
calcitrapa, L.	many		some	Salter. In mud under sea water.
ditto	56	150	nil	
cyanus, L.	14	88	nil	
ditto	50	30	nil	
ditto	1400 ?		some	Des Moulins. Seed from a Roman tomb.
dealbata, Willd.	15	20	nil	A. de C.
ditto	50	18	nil	
Jacea, L.	53	150	nil	
sempervirens, L.	15	20	nil	A. de C.
Centranthus ruber, D. C.	50	42	nil	
ditto	15	20	nil	A. de C.
ditto	700		some	Gard. Mag. 1836. Supp. age in soil.
Cerastium oblongifolium, Torr.	67	200	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Centrantherum punctatum, Cass.	15	20	nil	A. de C.
Centunculus minimus, L.	15	115	nil	
ditto	18?		few	Peter. Supp. age in soil.
ditto	32		few	Peter. Supp. age in soil.
ditto	77	84	nil	
ditto	48	58	nil	
ditto	57	110	nil	
Cephalaria alpina, Schrad.	50	17	nil	
leucantha, Sch.	40	140	nil	
procera, Fisch. and Ave-Lall.	50	15	nil	
rigida, Roem. and Schult.	15	20	nil	A. de C.
Cerastium arvense, L.	67	100	nil	
ditto	100?		few	Peter. Supp. age in soil.
glomeratum, Thuill.	57	1000	nil	
oblongifolium, Torr.	67	200	nil	
tetrandrum, Curt.	57	210	nil	
ditto	57	92	nil	
tetrandrum, Curt., var. atrovirens, Bab.	57	67	nil	
ditto	67	150	nil	
triviale, Link.	16	180	nil	
ditto	20?		few	Peter. Supp. time buried.
ditto	45?		few	Peter. Supp. time buried.
Ceratopetalum gummiferum, Sm.	57	50	nil	
Chaerophyllum bulbosum, L. (Tuberous Chervil).	1	100*	50	Vilmorin. Ext. limit, 2 yrs.

	Years old.	No. of Seeds.	Per cent. Germ.	
Chamaescilla corymbosa, F. v. M.	37	35	nil	
Cheiranthus Cheiri, L. (Wall Flower).	50	160	nil	
Chelidonium majus, L.	15	20	nil	A. de C.
majus, var. placiniatum	50	96	nil	
Chenopodiaceae	25		nil	Becquerel.
Chenopodium album, L.	1	67*	58	Duvel. Buried in soil 64 per cent.
ditto	28	170	nil	
ditto	20		few	Peter. Supp. time buried.
ditto	20	500	nil	
ditto	41	500	nil	
ditto	70	150	nil	
ditto	67	200	nil	
ambrosoides, L.	49	52	nil	
Bonus-Henricus, L. (Goosefoot, Good King Henry).	3	100*	50	Vilmorin. Ext. limit, 5 yrs.
ditto	43	250	nil	
Botrys, L.	21	500	nil	Same with various tests after 5 and 10 min. in acid.
ditto	16	250	nil	
capitatum, Aschers.	50	168	nil	
ditto	15	20	nil	A. de C.
ditto	72	150	nil	
ditto	49	250	nil	
ficifolium, Sm.	47	250	nil	
glaucum, L.	54	250	nil	
ditto	48	50	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
hybridum, L.	81	100	nil	
ditto	1	61*	18	Duvel. Buried in soil 13 per cent.
murale, L.	72	200	nil	
ditto	74	145	nil	
nitrariaceum, F. v. M.	57	50	nil	
opulifolium, Schrad.	43	280	nil	
ditto	43	200	nil	After 5 min. in acid.
paniculatum, Hook.	50	42	nil	
polyspermum, L.	29	400	nil	
ditto	30		nil	Becquerel.
ditto	42	300	nil	
ditto	74	150	nil	
ditto	77	200	nil	
ditto	35?		many	Peter. Supp. age in soil.
ditto	49	500	nil	
ditto	57	110	nil	
procerum, Hochst.	69	200	nil	
Quinoa, Willd. (White Quinoa).	4	100*	50	Vilmorin. Ext. limit, 5 yrs.
ditto	41	500	nil	
ditto	50	92	nil	
ditto	61	120	nil	
ditto	41	250	nil	
rubrum, L.	64	500	nil	
ditto	77	500	nil	
Chiloglottis diphylla, R. Br.	37	2000	nil	
Chloris acicularis, Lindl., var. Moorei, F. v. M.	57	100	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
truncata, R. Br.	57	100	nil	
Chorizandra enodis, Nees.	40	20	nil	
Chorizema cordatum, Lindl.	50	20	nil	
Chrysanthemum Balsamita, L.	50	145	nil	
Broussonetii, Balb.	50	25	nil	
coronarium, L.	15	20	nil	A. de C.
corymbosum, L.	15	20	nil	A. de C.
ditto	15	20	nil	
ditto	50	110	nil	
daucifolium, Pers.	15	20	nil	A. de C.
lacustre, Brot.	50	80	nil	
Leucanthemum, L.	10	34	nil	
ditto	20?		few	Peter. Supp. time in soil.
ditto	36?		few	Peter. Supp. time in soil.
ditto	50	62	nil	
ditto	1	96*	91	Duvel. Buried in soil 49 per cent.
Myconis, L.	50	96	nil	
Parthenium, Bernh.	50	120	nil	
viscosum, Desf.	50	52	nil	
Cicer arietinum, L. (Chick Pea).	3	100*	50	Vilmorin. Ext. limit, 8 yrs.
ditto	10	50	nil	
ditto	12		nil	Nobbe.
ditto	17	8	2.5	
Cichorium Endivia, L. (Endive).			some	Berkeley. After 30 days in sea water.
ditto			some	Thuret. After 13 m. floating on sea water.
ditto	10	100*	50	Vilmorin. Ext. limit, 10 yrs.

	Years old.	No. of Seeds.	Per cent. Germ.	
Intybus, L. (Common Chicory).	8	100*	50	Vilmorin. Ext. limit, 10 yrs.
ditto	12		35	Nobbe.
Circaea lutetiana, L.	61	62	nil	
ditto	67	33	nil	
Cistus, various sp.			many	D. After 36 days in sea water.
ditto			some	D. After 70 days in sea water.
hirsutus, Lam.	50	200	nil	
monspeliensis, L.	15	20	nil	A. de C.
villosus, L.	15	20	nil	A. de C.
ditto	50	100	nil	
Citriobatus multiflorus, A. C.	12	100	nil	
Citrullus Colocynthis, Sch. (Fancy Gourd)	6	100*	50	Vilmorin.
ditto	10		some	Vilmorin.
ditto	11	100	nil	Filed. Acid chars surface, and rapidly penetrates hard, unswollen seeds.
ditto	49	54	nil	
ditto	26	52	nil	6 weeks at 30 deg. C., all soft.
vulgaris, Sch. (Water Melon).	5	100*	50	Vilmorin. Ext. limit, 10 yrs.
ditto	1		nil	Duvel. If buried, died.
Cladanthus proliferus, D. C.	50	230	nil	
Cladium Filum, R. Br.	54	250	nil	
germanicum, Schrad.	64	75	nil	
germanicum, Schrad. var. mariscus, L.	58	200	nil	
Clarkia pulchella, Pursh.			many	D. After 28 days in sea water.
ditto			nil	D. After 54 days in sea water.

	Years old.	No. of Seeds.	Per cent. Germ.	
Claytonia australasica, Hook.	54	20	nil	
ditto	57	60	nil	
perfoliata, Don. (Cuban Winter Purslane).	5	100*	50	Vilmorin. Ext. limit, 7 yrs.
ditto	50	24	nil	
Clematis apiculata, Hook. f.	50	22	nil	
aristata, R. Br.	54	83	nil	
glycinoides, D. C.	54	150	nil	
microphylla, D. C.	50	14	nil	
ditto	54	19	nil	
recta, L., var. parviflora.	50	22	nil	
recta, L., var. nana.	50	52	nil	
recta, L., var. lathyrifolia, Bess.	50	52	nil	
reticulata, Walt.	50	10	nil	
virginiana, L.	67	85	nil	
Cleome graveolens, Rafin.	67	40	nil	
serrata, Jacq., var. triphylla, L.	15	20	nil	A. de C.
viscosa, L.	15	20	nil	A. de C.
Clerodendron tomentosum, R. Br.	50	13	nil	
Clethra mexicana, D. C.	18	82	nil	
Clianthus Dampieri, Cunn.	47	16	nil	
Cnicus arvensis, Hoffm.	1	57*	68	Duvel. Buried deeply, 28.5 per cent.
ditto	15	80	nil	
ditto	20?		few	Peter. Supp. time buried.
ditto	45		few	Peter. Supp. time buried.
ditto	100?		few	Peter. Supp. time buried.

	Years old.	No. of Seeds.	Per cent. Germ.	
cynaroides, Willd.	50	15	nil	
eriophorus, Roth.	15	20	nil	A. de C.
lanceolatus, Willd.	18	96	nil	
ditto	36?		few	Peter. Supp. time in soil.
ditto	57	65	nil	
oleraceus, L.	6	100*	50	Vilmorin.
syriacus, Roth.	50	33	nil	
Cochlearia acaulis, Desf.	50	50	nil	
glastifolia, L.	15	20	nil	A. de C.
ditto	50	80	nil	
officinalis, L. (Scurvy Grass).	4	100*	50	Vilmorin. Ext. limit, 7 yrs.
Cocos nucifera, L.			some	After 1 yr. floating on sea water.
plumosa, Hook.	7	30	nil	
Codonocarpus australis, A. Cunn.	10	36	nil	
cotinifolia, F. v. M.	57	100	nil	
ditto, var. pungens, Lindl.	57	50	nil	
Coffea arabica, L. (Coffee).	½		nil	Wiesner.
Colchicum autumnale, L.			nil	Berkeley After 1 month in sea water.
Coleanthus subtilis, Sied.	many		some	Sirodot. In soil.
ditto	34	115	nil	
ditto	42	135	nil	
Coleus scutellarioides, Benth.	15	20	nil	A. de C.
Collinsia bicolor, Benth.	50	44	nil	
grandiflora, Dougl.	50	33	nil	
parviflora, Lindl.	50	75	nil	
Collomia coccinea, Lehm.	50	32	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
grandiflora, Dougl.	50	33	nil	
linearis, Nutt.	50	156	nil	
Colutea cruenta, Ait.	50	16	nil	
halepica, Lam.	50	17	nil	
Comesperma ericinum, D. C., var. acutiflora, Steetz.	57	100	nil	
ericinum, D. C., var. linarifolia, Cunn.	54	30	10	Slight protrusion of radicle only. No complete seedlings.
retusum, Lab.	57	100	nil	
Commersonia Fraseri, J. Gay.	47	45	nil	
Conium maculatum, L.	15	20	nil	A. de C.
ditto	45	50	nil	
ditto	35	50	nil	
ditto	50	100	nil	
ditto	50	210	nil	
ditto	59	140	nil	
ditto	61	100	nil	
Conospermum Stoechadis, Endl.	9	50	nil	
Conringia orientalis, Dum.	15	20	nil	A. de C.
Convolvulaceae.	25		nil	Becquerel.
Convolvulus arvensis, L.	10	84	11	
ditto	20?		few	Peter. Supp. time buried.
ditto	55	62	nil	All sw. water.
Convolvulus arvensis, L., var. sepium.	1	4*	2	Duvel. Buried in soil 7 per cent.
ditto	10	6	nil	Sw. slowly in water.
ditto	15	20	nil	A. de C.

	Years old.	No. of Seeds.	Per cent. Germ.	
erubescens, Sims.	52	35	nil	Sw. in water.
ditto	52	12	nil	1 hr. in acid.
ditto	57	42	nil	Sw. slowly in water.
		8	nil	Sw. after 1 hr. in acid.
mauritanicus, Boiss.	10	250	37.6	45 sw. in water; all dead. Rest after ½ hr. in acid; 94 germ.
siculus, L.	50	35	nil	
tricolor, L.			many	D. After 7 days in sea water.
undulatus, Cav.	50	27	nil	
Conyza ivaefolia, Less.	47	45	nil	
Coprosma Billardieri, Hook. and C. hirtella, Lab.	47	150	nil	
Billardieri, Hook. f., var. microphylla, A. Cunn.	57	30	nil	
hirtella, Labill.	47	150	nil	
ditto	54	15	nil	
Coptis trifoliata, Salisb.	67	33	nil	
Corchorus capsularis, L.	10	500	5	
olitorius, L. (Bristly-leaved C.)	5	100*	50	Vilmorin. Ext. limit, 10 yrs.
olitorius, L.	15	20	nil	A. de C.
ditto	10	500	36	
Cordyline australis, Hook. f.	50	22	nil	
Coreopsis lanceolata, L.	83	20	nil	
ditto	50	170	nil	
Coriandrum sativum, L. (Coriander).	6	100*	50	Vilmorin. Ext. limit, 8 yrs.
sativum, L.	16		nil	Giglioli. In hydrogen.

	Years old.	No. of Seeds.	Per cent. Germ.	
Cornus Amomum, Mill., var. sericea, L.	67	55	nil	
candidissima, Mill, var. paniculata, L'Herit.	67	30	nil	
stolonifera, Michx.	67	20	nil	
Coronilla Emerus, L.	15	20	nil	A. de C.
juncea, L.	15	20	nil	A. de C.
valentina, L.	15	20	5 to 15	A. de C.
varia, L.	50	22	nil	
Corrigiola littoralis, L.	15	20	nil	A. de C.
ditto	55	52	nil	
Corydalis aurea, Willd.	16	82	nil	
ditto	50	140	nil	
bulbosa, D. C., var. digitata, Pers.	65	45	nil	
claviculata, D. C.	many		nil	Poisson.
ditto	30		nil	Becquerel.
ditto	102	50	nil	
ditto	46	60	nil	
fabacea, Pers.	67	33	nil	
glauca, Pursh.	50	188	nil	
lutea, D. C.	5	100	nil	Air dried.
pruinosa, E. Mey.	15	17	nil	
tuberosa, D. C., var. cava, S. and K.	15	1000	nil	
ditto	17	200	nil	
Corylus Avellana, L.			some	D. After 90 days floating on sea water.
rostrata, Ait.	67	10	nil	
Cosmos lutea, D. C.	fresh		nil	Berkeley. After 30 days in sea water.

	Years old.	No. of Seeds.	Per cent. Germ.	
Cotoneaster bacillaris, Wall.	50	16	nil	
buxifolia, Wall.	50	22	nil	
buxifolia, Wall, var. affinis, D. C.	50	14	nil	
buxifolia, Wall, var. marginata.	50	33	nil	
nummularia, Fisch and Mey.	50	18	nil	
thymaefolia, Hort.	50	11	nil	
ditto, var. microphylla, Wall.	50	15	nil	
Cotula Filicula, Hook. f.	54	100	nil	
Crambe hispanica, L.	15	20	nil	A. de C.
maritima, L. (Sea Kale).	1	100*	50	Vilmorin. Ext. limit, 7 yrs.
Cramtzia lineata, Nutt., var. australasica.	57	41	nil	
Craspedia pleiocephala, F. v. M.	57	500	nil	
Richea, Cass.	56	1000	nil	
Crassula tetragona, L.	50	60	nil	
Crataegus aestivalis, Torr. and Gray.	50	12	nil	
coccinea, L. var. macracantha.	50	12	nil	
cordata, Ait., var. acerifolia.	50	12	nil	
Crus galli, L.	26	24	nil	
orientalis, Bieb., var. odoratissima.	50	10	nil	
Oxyacantha, L.	fresh	100	54	Shelled, and at 30 deg. C. for 2 months.
ditto	fresh	100	nil	Shelled, and at 15-20 deg. C. for 2 m.
ditto	fresh		nil	In nature. Crocker.
ditto	1		many	In nature. Crocker.
ditto	2		few	In nature. Crocker.
ditto	37	30	nil	Endocarp filed nearly through.
ditto	37	25	nil	Endocarp cracked.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	50	14	nil	
Pyracantha, Medic.	50	10	nil	
Crepis aspera, L.	15	20	nil	A. de C.
Cressa cretica, L.	57	60	nil	
Crithmum maritimum, L. (Samphire)	1	100*	50	Vilmorin. Ext. limit, 3 years.
maritimum, L.	57	110	nil	
Crotalaria laburnifolia, L.	10	27	74	All but 3 sw. without filing.
laburnifolia, L., var. capensis.	8	28	7	
Mitchellii, Benth.	13	14	21.4	Sw. in water.
		100	78	After $1\frac{3}{4}$ hr. in acid.
Novae Hollandiae, D. C.	57	30	nil	Not quite ripe. Sw. in water.
paniculata, Willd.	20	30	nil	All sw. in water.
ramosissima, Roxb.	38		some	Becquerel.
vitellina, Ker. Gawl.	13	7	43	Sw. in water.
		100	92	Sw. after 1 hr. in acid.
Crucianella augustifolia, L.	50	104	nil	
latifolia, L.	15	20	nil	A. de C.
Cruciferae.	25		nil	Becquerel.
Cryptandra parvifolia, Turcz.	54	100	nil	
spinescens, Sieb.	57	30	nil	
Cryptocarya glaucescens, R. Br.	12	30	nil	
insignis, Bailey.	10	20	nil	
Cryptostylis longifolia, R. Br.	57	1000	nil	
Cucumis Anguria, L. (W. India Gherkin).	6	100*	50	Vilmorin. Limit over 7 yrs.
Melo, L. (Melon).			some	Berkeley. After 30 days in sea water.
ditto	1	96.5*	97	Duvel.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	1	96.5*	nil	Buried.
ditto	5	100	64	
ditto	5	100*	50	Vilmorin. Ext. limit, 10 yrs.
Melo, L., var. flexuosus, L. (Snake Cucumber).	7 to 8	100*	50	Vilmorin. Ext. limit, 10 yrs.
Melo, L., var. Dudaim, L.	15	20	nil	A. de C.
Melo, var. serotinus, Haberl.	15	20	nil	A. de C.
prophetarum, L.	6	100*	50	Vilmorin.
sativus, L. (Cucumber).	10	100*	50	Vilmorin. Ext. limit, 10 yrs.
Cucurbita.	15		some	Poisson.
digitata, A. Gray.	13	16	nil	
maxima, Duchesne.	6	100*	50	Vilmorin. Ext. limit, 10 yrs.
moschata, Duchesne.	6	100*	50	Vilmorin. Ext. limit, 10 yrs.
Pepo, L.	fresh		some	D. After 100 days in cold sea water.
Pepo, L., var. Melo.	fresh	4	50	D. After 82 days in cold sea water.
ditto (Custard Marrow).	6	100*	50	Vilmorin. Ext. limit, 10 yrs.
ditto			some	Mart. After 93 days fl. on sea water.
ditto	fresh	100	50	Des. 42 days at 37 deg. C.
ditto	fresh	100	90	Des. 56 days to 0.87 per cent. water.
ditto	6	100*	50	Vilmorin. Ext. limit 10 yrs.
ditto	11	12	nil	
ditto	14	26	nil	
Cucurbitaceae.	25		nil	Becquerel.
Cuminum Cyminum, L. (Cumin).	1	100*	50	Vilmorin. Ext. limit, 5 yrs.
Cupania anacardioides, A. Rich.	10	33	nil	
semiglauca, F. v. M.	10	50	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Cuphea viscosissima, Jacq.	15	20	nil	A. de C.
Cupressus Lawsoniana, Andr.	10	40	nil	
macrocarpa, H., var. Lambertiana.	8	400	nil	
ditto	10	58	nil	
sempervirens, L., var. horizontalis	50	87	nil	
sempervirens, L., var. pyramidalis	15	20	nil	A. de C.
Cuscuta australis, R. Br.	57	30	nil	
ditto, var. Polygonorum.	1	12*	8.5	Duvel. Buried deeply in soil, 13 per cent.
corymbosa, Rinz. and Pav.	8	350	8.5	
europaea, L.	10	500	5.8	
ditto	6	300	11.2	
ditto	57	80	nil	
ditto	59	100	nil	
Epilinum, Weihe.	1		nil	Duvel. Buried deeply, 34 per cent.
ditto	10	600	nil	
ditto	5	600	4.2	
Epithymum, Murr.	4	200	6.3	
ditto, var. Trifolii, Bab.	56	120	nil	
Gronovii, Willd.	9	400	12.8	
Cyathodes acerosa, R. Br.	53	40	nil	
parvifolia, R. Br.	57	10	nil	
Cyclamen latifolium, Sibth. and Sm. var. persicum, Mill.	15	20	nil	A. de C.
Cynara Cardunculus, L. (Cardoon).	7	100*	50	Vilmorin. Ext. limit, 9 yrs.
ditto	16		nil	Giglioli. In hydrogen.
ditto	6	100*	50	Vilmorin. Ext. limit, 10 yrs.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	12		nil	Nobbe.
Cynodon Dactylon, Pers.	54	35	nil	
Cynosurus cristatus, L.	68	100	nil	
echinatus, L.	57	100	nil	
Cyperus esculentus, L.	1		nil	Duvel. If buried, died.
rotundus, L. (Nut Sedge).	3.4	100*	50	Vilmorin. Ext. limit, 5 yrs.
strigosus, L.	67	1000	nil	
Cytisus albus, Link.	13	100	31	Only 2 sw. without sand-p. Both died.
ditto	51	54	78	Most only after filing.
albus, var.	50	11	nil	
alpinus, Lam., var. Scoticus.	50	15	nil	
austriacus, L.	62		some	Becquerel.
biflorus, L. Herit.	83		some	Becquerel.
canariensis, Steud.	50	220	nil	
candicans, Lam.	80	80	2.5	Sw. in water.
		8	62	Sw. after 2 hr. in acid.
capitatus, Scop., var. uraliensis.	50	15	nil	
Lupinus, Gromow.	50	13	nil	
purpurens, Scop.	50	14	nil	
scoparius, Link.	50	43	nil	
sessilifolius, L.	50	15	nil	
triflorus, L. Herit.	50	3	nil	Sw. in water.
		247	18	Sw. after 4 hr. in acid.
Damasonium australe, Salisb.	57	150	nil	
australe, Salisb., var. pumilum.	57	50	nil	
stellatum, Thuill.	55	64	nil	

	Years old.	No. of Seeds.	Per cent Germ.	
Danthonia bipartita, F. v. M.	18	150	nil	
ditto	57	100	nil	
decumbens, D. C.	64	114	nil	
pilosa, R. Br.	42	86	nil	
ditto	55	20	nil	
pilosa, R. Br.; var. alpina.	54	107	nil	
pilosa, R. Br., var. glabra, F. v. M.	54	60	nil	
pilosa, R. Br., var. nudiflora.	57	56	nil	
robusta, F. v. M.	54	102	nil	
Daphnandra micrantha, Benth.	15	22	nil	
Daphne Laureola, L.	81	54	nil	
Datisca cannabina, L.	15	20	nil	A. de C.
Datura Stramonium, L.	50	136	nil	
stramonium, L., var. Tatula, L.	1	99*	54	Duv. Buried deeply, 86 per cent.
ditto	15	20	nil	A. de C.
Daucus Carota, L.	fresh		10	Berkeley. After 56 days in sea water.
ditto			few	Berkeley. After 85 days in sea water.
ditto	4 to 5	100*	50	Vilmorin. Limit, over 10 yrs.
ditto	3	200	64	French grown.
ditto	3	200	35	English grown.
Carota, L., Long Horn.	12	250	nil	
Carota, L., Early Scarlet.	13	420	nil	
Carota, L.	20?		few	Peter. Supp. time in soil.
ditto	36?		few	Peter. Supp. time in soil.
Daviesia cordata, Sm.	67	150	1.3	98 sw. and 2 germ. only after sand-p.
corymbosa, Sm., var. virgata.	55	15	nil	All sw. in water.

	Years old.	No. of Seeds.	Per cent. Germ.	
crenulata, Turcz., var. parviflora.	18	17	59	In acid 3 hr.
ditto	18	15	33	Sw. in water.
Delphinium Consolida, Linn.	50	92	nil	
Dendrocalamus giganteus, Munro.	13	250	nil	
Hamiltonii, Rees and Arn.	15	34	nil	
Desmanthus brachylobus, Benth.	15	20	5-15	A. de C.
Deyeuxia Forsteri, Kunth.	55	200	nil	
frigida, F. v. M.	54	80	nil	
Mulleri, Benth.	57	200	nil	
nivalis, Benth.	54	100	nil	
quadriseta, R. Br.	57	67	nil	
scabra, Kunth.	54	48	nil	
ditto	54	150	nil	
Dianella longifolia, R. Br.	47	210	nil	
ditto	50	60	nil	
revoluta, R. Br.	40	62	nil	
tasmanica, Hook. f.	18	13	nil	
Dianthus barbatus, L.	50	52	nil	
Carthusianorum, L.	50	56	nil	
plumarius, L.	50	48	nil	
ditto	50	44	nil	
Dichelachne crinita, Hook. f.	55	100	nil	
Digitalis lanata, Ehrh.	15	20	nil	A. de C.
lutea, L., var. intermedia, Pers.	15	20	nil	A. de C.
orientalis, Lam.	15	20	nil	A. de C.
purpurea, L.	15	20	nil	A. de C.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	50	149	nil	
ditto	30		nil	Becquerel.
Dillwynia ericifolia, Sm.	12	100	68	After $2\frac{1}{2}$ hr. in acid nearly all sw.
ditto	25	120	22	Sw. after 3 hr. in acid.
ericifolia, Sm., var. glaberrima.	50	7	nil	
floribunda, Sm.	12	50	46	After 1 hr. in acid.
ditto	32	64	19	All sw. after 2 hr. in acid.
Dimorphotheca pluvialis, Moench.	50	47	nil	
Dioclea pauciflora, Rusby.*	64		some	Becquerel.
Diplotaxis, pendula, D. C.	53	1000	nil	
tenuifolia, D. C.	18	250	nil	
ditto	40	500	nil	
viminea, D. C.	45	150	nil	
Diplothemium maritimum, Mart.	8	11	nil	
Dipsacus fullonum, L.	15	20	nil	A. de C.
ditto	16	48	nil	
ditto	65	50	nil	
pilosus, L.	30	55	nil	
ditto	55	46	nil	
ditto	60	62	nil	
sylvestris, Mill.	22	84	nil	
ditto	50	25	nil	
Discaria australis, Hook.	55	45	nil	
Distichlis maritima, Rafin.	57	200	nil	
Diuris sulphurea, R. Br.	57	800	nil	

* Doubtful record, since, according to Kew Index, the plant was only described (Mem. Torr. Bot. Club, vi., 25), at a much later date.

	Years old	No of Seeds	Per cent. Germ.	
Dodonaea attenuata, A. Cunn., var. Preissiana, Miq.	57	100	nil	
ditto	50	28	nil	
lobulata, F. v. M.	47	20	nil	Filed.
viscosa, Jacq., var. asplenifolia.	57	55	nil	
asplenifolia, Rudge., var. conferta.	57	100	nil	
Dolichos biflorus, L.	47	65	nil	All sw. in water.
ditto	47	14	nil	All sw. in water.
brasiliensis	15	20	5 to 15	A. do C.
falcatus, Klein.	10	22	nil	
funarius, Moll.	37		some	Becquerel.
Lablab, L.	3	100*	50	Vilmorin. Ext. limit, 8 yrs.
ditto	10	67	8	
ditto	41	8	nil	All sw. in water.
ditto	50	9	nil	
Lablab, L., var. lignosus.	50	33	nil	
Lablab, Linn, var. purpureus,	10	20	nil	
surinamensis?	12		nil	Nobbe.
Doronicum austriacum, Jacq.	50	100	nil	
Doryanthes excelsa, Correa.	11	40	nil	
Drimys aromatica, F. v. M.	54	68	nil	
Drosera longifolia, L.	67	148	nil	
rotundifolia, L.	20	122	nil	
Drymophila cyanocarpa, R. Br.	50	20	nil	
Duboisia myoporoides, R. Br.	10	70	1.4	
ditto	15	120	nil	

	Years old	No. of Seeds	Per cent. Germ.	
Duranta Plumieri, Jacq.	50	20	nil	
Dysodia chrysanthemoides, Lag.	15	20	nil	A. de C.
Dysoxylum rufum, Benth.	57	30	nil	
Ecballium Elaterium, A. Rich.	44	100	nil	
Echinopogon ovatus, Beauv.	57	100	nil	
Echinospermum Lappula, Lehm.	15	20	nil	A. de C.
Echium violaceum, L.	50	45	nil	
vulgare, L.	300		nil	Nobbe. Old herb.
Eclipta erecta, Linn.	15	20	nil	A. de C.
Eichornia, sp.	ripe		nil	Coats intact. Crocker.
ditto	ripe		98	Coats broken. Crocker.
Elaeocarpus cyaneus, Sims.	57	32	nil	
eumundi, F. M. Bailey	12	35	nil	
ovalis, Miq.	50	20	nil	
Eleocharis obtusa, Schult.	67	140	nil	
ovata, R. Br.	many		some	Sirodot. Supp. age in soil.
ditto	25	180	nil	
Elephantopus scaber, L.	15	20	nil	A. de C.
Eleusine aegyptiaca, Desf.	12	500	nil	
aegyptiaca, Desf., var. cruciata.	8	250	12	In 2 to 14 weeks, without filing.
ditto	18	170	nil	
coracana, Gaertn.	10	1000	nil	
ditto	15	20	nil	A. de C.
indica, Gaertn.	1	78*	75	Duvel. Buried in soil; all died.
oligostachya, Link.	45	500	nil	
stricta, Roxb.	13	400	nil	Sand-p.

	Years old.	No. of Seeds.	Per cent. Germ.	
Ellisia Nyctelea, Linn.	15	20	nil	A. de C.
Elymus canadensis, L.	1	93.5*	95.5	Duvel. Buried deeply, 22 per cent.
condensatus, J. and C. Presl., var. triticoides, Buckl.	1	84*	75	Duvel. Buried deeply, 15.5 per cent.
virginicus, L.	1	65*	44	Duvel. Buried Deeply, 25.5 per cent.
Emex Australis, Steinh., var. Centropodium, Meissn.	57	60	nil	
spinosa, Campd.	15	20	5-15	A. de C.
Enchylaena tomentosa, R. Br.	47	40	nil	
Endiandra Sieberi, Nees.	+10	3	nil	Large seed.
Entada Pursaetha, D. C.	years		some	Hemsley. Several years in sea water.
ditto	33	8	nil	Water very slowly absorbed through scar.
scandens, Benth.	+10	2	50	
ditto	fresh		some	Guppy. After months on sea water.
Entelea arborescens, R. Br.	51	76	47.3	In 12 weeks, without filing.
Epacris heteronema, Labill.	22	250	nil	
ditto	54	500	nil	
ditto	57	200	nil	
lanuginosa, Labill.	18	52	nil	
ditto	57	500	nil	
microphylla, R. Br.	20	110	nil	
ditto	57	400	nil	
obtusifolia, Sm.	24	84	nil	
ditto	57	300	nil	
Epaltes australis, Less.	57	100	nil	
Ephedra distachya, Linn.			some	Mart. After 93 days fl. on sea water.

	Years old	No. of Seeds	Per cent Germ		
Epilobium alpinum, L.	50	53	nil		
angustifolium, L.	55	1000	nil		
ditto	58	200	nil		
Billardierianum, Ser.	57	100	nil		
ditto	57	100	nil		
Billardierianum, var. micranthum.	57	200	nil		
hirsutum, L.	many		many	Salter.	In mud under sea water.
ditto	10	140	nil		
ditto	15	20	nil	A. de C.	
ditto	58	200	nil		
Lamyi, F. Schultz.	55	110	nil		
montanum, Linn.	14	260	nil		
ditto	36?		few	Peter.	Supp. time in soil.
ditto	42	210	nil		
ditto	45?		some	Peter.	Supp. time buried.
ditto	100?		many	Peter.	Supp. age in ground.
roseum, Schrad.	61	64	nil		
Eragrostis amabilis, Wight and Arn., var. polymorpha.	57	114	nil		
Brownii, Nees.	54	118	nil		
lacunaria, F v. M.	18	100	nil		
ditto	57	100	nil		
pilosa, Beauv., var. parviflora.	54	500	nil		
ditto	15	20	nil	A. de C.	
ditto	15	20	nil	A. de C.	
Ercilla volubilis, A. Juss.	50	26	nil		

	Years old.	No. of Seeds	Per cent. Germ.	
Eremophila bignoniflora, F. v. M.	47	50	nil	
polyclada, F. v. M.	57	100	nil	
Erianthus strictus, Baldw.	15	20	nil	A. de C.
Erigeron acris, L.	22	240	nil	
ditto	55	500	nil	
canadensis, L.	12	160	nil	
ditto	56	1000	nil	
conyzoides, F. v. M.	17	1200	nil	
ditto	57	300	nil	
glabellus, Nuth.	50	86	nil	
Eriophorum angustifolium, Roth.	58	59	nil	
gracile, Koch.	64	100	nil	
latifolium, Hoppe.	55	99	nil	
polystachion, L.	67	88	nil	
vaginatum, L.	56	52	nil	
Eriostemon ozothamnoides, F. v. M.	57	120	nil	
phylicoides, F. v. M.	57	38	nil	
pungens, Lindl.	57	82	nil	
sediflorus, F. v. M.	57	150	nil	
trachyphyllus, F. v. M.	57	42	nil	
Erodium cicutarium, L. Herit., var. melanostigma.	15	20	nil	A. do C.
ditto, var. pimpinellaefolium, Sibth.	15	20	nil	A. de C.
maritimum, Sm.	57	52	nil	
laciniatum, Willd, var. pulverulentem.	15	20	nil	A. de C.

	Years old.	No. of Seeds.	Per cent. Germ.	
moschatum, L. Herit.	38	125	nil	
ditto	55	130	nil	
ditto	59	120	nil	
Eruca sativa, Mill. (Rocket).	4	100*	50	Vilmorin. Ext. limit, 9 yrs.
Eryngium giganteum, Bieb., var. asperifolium.	15	20	nil	A. de C.
maritimum, L.			some	Mart. After 45 days fl. on sea water.
ditto	65	132	nil	
Erysimum asperum, D. C., var. arkansanum.	10	250	nil	
cheiranthoides, L.	1	52*	42	Duvel. Buried deeply, 8 per cent.
ditto	15	100	nil	
cuspidatum, D. C.	15	20	nil	A. de C.
pannonicum, Crantz, var. strictum.	15	20	nil	A. de C.
Perofskianum, Fisch. and May.	fresh		many	D. After 36 days in sea water.
ditto		100	2	D. After 50 days in sea water.
ditto			nil	D. After 70 days in sea water.
Erythraea Centaurium, Pers.	10	180	nil	
ditto	16	210	nil	
ditto	30	250	nil	
ditto	100?		few	Peter. Supp. age in soil
linarifolia, Pers., var. littoralis.	56	210	nil	
ramosissima, Pers., var. pulchella.	37	1500	nil	
ditto	57	250	nil	
Erythrina indica, Lam.	8	44	48	Sw. after filing.
		6	nil	Sw. in water.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	32	63	7	Sw. after 3 hr. in acid.
Vespertilio, Benth.	15	20	25	After 3 hr. in acid.
Erythronium Dens-canis, L.	3	100	nil	Air dried.
Erythroxylum Coca, Lam.	17	15	nil	
Eschscholzia californica, Chan.	fresh		few	Berkeley. After 30 days in sea water.
ditto	50	82	nil	
Eucalyptus alpina, Lindl.	57	130	nil	
amygdalina, Labill.	11	1500	4.1	
botryoides, Sm.	10	10,000	8.5	
calophylla, R. Br.	10	120	96	
ditto	15	60	75	
ditto	20	32	12.5	
ditto	32	100	5	
ditto	50	45	nil	
coccifera, Hook. f.	11	1500	3.2	
cornuta, Lab.	10	2000	27	
ditto	22	180	9	
ditto	35	128	nil	
corynocalyx, F. v. M.	10	10,000	2.2*	
ditto	25	500	nil	
diversicolor, F. v. M.	14	100	86	Germ. in 5 days at 22 deg. C.
ditto	24	200	11	

* Eucalyptus. On re-testing with thinner sowing and removing seedlings daily, the percentages were approximately doubled. All the seeds were soaked and germinated in 3—15 weeks at 20 deg. C—33 deg. C. Where the older seed had a higher percentage than the lower, this appeared in all cases to be due to the latter containing a higher original percentage of infertile seed. No Eucalyptus seed appeared to have completely impermeable coats, though many absorbed water only slowly.

	Years old.	No. of Seeds.	Per cent. Germ.	
Eucalyptus diversicolor	50	150	nil	
dumosa, A. Cunn.	57	250	nil	
foecunda, Schau.	10	10,000	3.9*	
ditto	25	2000	nil	
globulus, Labill.	fresh	200	75	56 days in des. at 37 deg. C.
ditto	10	10,000	4.4*	
ditto	10	500	3	
ditto	20	1000	2.2	
ditto	32	500	nil	
gomphocephala, D. C.	30	2000	0.8	
ditto	45	550	nil	
goniocalyx, F. v. M.	10	5000	11	
ditto	15	2000	4	
Gunnii, Hook. f.	11	2500	2.2	
ditto	28	1200	nil	
ditto	57	250	nil	
incrassata, Lab., var. costata.	57	200	nil	
largiflorens, F. v. M.	57	83	nil	
leptopoda, Benth.	30	100	1.2	
ditto	45	500	nil	
miniata, A. Cunn.	13		some	Elliot. In Mueller's Eucalyptographia.
ditto	15	1000	4.3	
ditto	20	850	2.2	
ditto	48	280	nil	
obcordata, Turcz.	10	10,000	6.5	
ditto	15	500	8.2	

	Years old.	No. of Seeds.	Per cent. Germ.	
Eucalyptus obliqua, L. Herit.	fresh	200	68	Des. 56 days at 37 deg. C.
ditto	13	100	22	
ditto	21	200	nil	
ditto	25	180	1.1	
ditto	46	250	nil	
occidentalis, Endl.	57	200	nil	
odorata, Behr.	7	100	15	
ditto	10	200	10	
ditto	57	300	nil	
pauciflora, Sieber.	10	1000	7.2	
ditto	12	5000	5.8	
ditto	50	250	nil	
ditto, var phlebophylla.	54	250	nil	
paniculata, Sm.	10	10,000	4.3*	
patens, Benth.	10	5000	8.1	
pilularis, Sm.	11	500	25.6	
ditto	50	250	nil	
polyanthema, Sch.	54	31	nil	
punctata, D. C.	7	1200	18.2	
ditto	15	600	7	
ditto	10	3000	22	
ditto	15	10,000	7.5	
rostrata, Sch.	7	1000	28.5	
ditto	10	8000	8.3	
ditto	37	2000	6.1	
ditto	50	220	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Eucalyptus rudis, Endl.	10	10,000	12	
ditto	50	280	nil	
siderophloia, Benth.	10	10,000	2.1*	
Stuartiana, F. v. M.	25	100	nil	
tereticornis, Sm.	10	5000	8.2	
ditto	15	850	2.3	
urnigera, Hook. f.	11	1200	5.5	
ditto	57	520	nil	
viminalis, Labill.	10	10,000	11	
ditto	12	500	15	
ditto	17	100	nil	
ditto, var. fabrorum, Sch.	40	250	nil	
ditto	57	150	nil	
Eucharidium concinnum, Fisch. and Mey.	50	100	nil	
Euchlaena mexicana, Schrad.	13	14	nil	Remained undecomp. many weeks.
Eugenia Smithii, Poir.	10	30	nil	
Euonymus atropurpureus, Jacq.	50	30	nil	
europaeus, L., var. coccinea.	50	15	nil	
europaeus, L., var. latifolius.	50	12	nil	
europaeus, L., var. variegatus.	50	13	nil	
Eupatorium ageratoides, L. f.	12	130	nil	
ditto	67	140	nil	
cannabinum, L.	15	20	nil	A. de C.
purpureum, L.	16	250	nil	
ditto	67	280	nil	
sessilifolium, L.	15	20	nil	A. de C.

	Years old.	No. of Seeds.	Per cent Germ.	
Euphorbiaceae	25		nil	Becquerel.
Euphorbia Chamaesyce, L.	15	20	nil	A. de C.
ditto	57	88	nil	
ditto	57	100	nil	
Characias, L.	50	24	nil	
eremophila, A. Cunn. (deserticola).	57	10	nil	
exigua, L.	20	150	nil	
ditto	22?		few	Peter. Supp. age in soil.
ditto	55	28	nil	
helioscopia, L.	10	90	12	
ditto	20?		few	Peter. Supp. time buried.
ditto	28	35	nil	
ditto	36?		few	Peter. Supp. time in soil.
hypericifolia, L.	15	20	nil	A. de C.
Lathyris, L.	30		nil	Becquerel.
ditto	50	57	nil	
Paralias, L.	fresh		some	Mart. After 45 days fl. on sea water.
ditto	58	45	nil	
Peplus, L.	36?		few	Peter. Supp. age in soil.
ditto	57	100	3	After long soaking, rest died.
ditto	67	27	nil	
pilosa, L.	56	28	nil	
platyphyllus, L.	60	32	nil	
Terracina, L.	15	20	nil	A. de C.
Euphrasia alpina, R. Br.	57	50	nil	
Eustrephus latifolius, R. Br., var. Brownii.	10	82	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
latifolius, R. Br.	50	13	nil	
ditto	57	15	nil	In acid ½ hr.
Eutaxia empetrifolia, Sch.	57	50	8	Berkeley. After 30 days in sea water.
Eutoca viscida, Torr.	fresh		nil	
ditto	50	65	nil	
Exocarpus latifolius, R. Br.	67	55	nil	
Fagelia bituminosa, D. C.	50	16	nil	
Fagopyrum esculentum, Moench.	1	100*	98.5	Duvel. If buried, all died.
tataricum, Gaertn.	15	20	nil	A. de C.
ditto	12		nil	Nobbe.
Fagus sylvatica, L.	12	54	nil	
ditto	50	13	nil	
Fedia Cornucopiae, Gaertn.	4	100*	50	Vilmorin Ext. limit, 7 yrs.
ditto	10		nil	
ditto			some	Berkeley. After 30 days in sea water.
ditto	50	59	nil	
ditto, var. graciliflora.			some	Berkeley. After 30 days in sea water.
Felicia angustifolia, Nees.	50	59	nil	
Ferraria undulata, L.	50	17	nil	
Festuca delicatula, Lag.	15	20	nil	A. de C.
elatior, Linn.	1	97*	83	Duvel. Buried deeply, 0.5 per cent.
ditto	8	100	nil	
elatior, Linn., var. pratensis, Linn.	fresh		26	Nobbe.
ditto	3		9	
ditto	12	200	nil	
littoralis, Labill.	14	88	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	15	20	nil	A. de C.
ditto	54	100	nil	
Loliacea, Huds.	66	86	nil	
nutans, Spreng.	67	140	nil	
ovina., L., var. heterophylla, Wahlenb.	12		nil	Nobbe.
ovina, L.	fresh		21	Nobbe.
ditto	3		7	Nobbe.
ditto	10	120	nil	
rigida, Kunth.	55	150	nil	
ditto	60	61	nil	
rubra, L.	fresh		23	Nobbe.
ditto	3		6	Nobbe.
ditto	13	150	nil	
tenella, Willd.	16	200	nil	
ditto	67	50	nil	
Ficus macrophylla, Desf.	7	1500	nil	
rubiginosa, Desf., var. australis.	12	250	nil	
ditto	57	50	nil	
rubiginosa, Desf.	12	250	nil	
ditto	17	250	nil	
Filago minima, Fries.	14	300	nil	
ditto	45?		few	Peter. Supp. time buried.
ditto	50	250	nil	
Flaveria Contrayerba, Pers.	15	20	nil	A. de C.

	Years old.	No. of Seeds.	Per cent. Germ.	
repanda, Lag.	15	20	nil	A. de C.
Flindersia australis, R. Br.	12	30	3.3	
ditto	25	38	nil	
Foeniculum vulgare, Mill. (Fennel).	fresh		many	D. C. Cooled 100 times to 50 deg. C.
vulgare (Bitter fennel).	4	100*	50	Vilmorin. Ext. limit, 7 yrs.
ditto	10	150	nil	
ditto	61	180	nil	
vulgare, var. (Long fennel).	4	100*	50	Vilmorin. Ext. limit, 7 yrs.‡
ditto	12	100	nil	
vulgare (Florence fennel).	4	100*	nil	Vilmorin. Ext. limit, 5 yrs.
ditto	15	250	nil	
Fragaria vesca, L. (Strawberry)	3	100*	50	Vilmorin. Ext. limit, 6 yrs.
ditto	11	400	nil	
ditto	35?		few	Peter. Supp. age in soil.
ditto	36?		few	Peter. Supp. age in soil.
ditto	45?		few	Peter. Supp. age in soil.
ditto	55	142	nil	
ditto	67	80	nil	
ditto	100?		few	Peter. Supp. age in soil.
Francoa sonchifolia, Cav.	50	200	nil	
Frankenia pulverulenta, L.	15	20	nil	A. de C.
Fraxinus americana, L.	1	49.5*	2	Duvel. Buried deeply, 84 per cent.
Fritillaria Imperialis, L.	50	25	nil	
Fugosia cuneiformis, Benth.	30	200	nil	Sw. in water.

‡ In all the Vilmorin records the number 50 in the germination column means that more than half the seeds originally germinable retained the p wer of germination at the age given.

	Years old.	No. of Seeds.	Per cent. Germ.	
Fumaria densiflora, var. micrantha, D. C.	56	120	nil	
officinalis, L.	18	78	nil	
parviflora, Lam.	55	80	nil	
Gagea pusilla, Schült. f., var. arvensis.	5	100	nil	Air dried.
Gahnia psittacorum, Lab.	33	100	nil	
Galega orientalis, Lam.	51	48	2	Sw. in soaking.
Galeopsis Ladanum, L.	55	71	nil	
Tetrahit, Linn., var. bifida.	110?		few	Peter. Supp. age in soil.
ditto	18	66	nil	
versicolor, Curt.	15	20	nil	
Galinsoga parviflora, Cav.	12	250	nil	
ditto	50	580	nil	
Galium, sp.	14	54	nil	
anglicum, Huds.	30		nil	Becquerel.
ditto	cent'r's		some	Michalet.
anisophyllum, Vill.	46	140	nil	
Aparine, Linn. (Vaillantii).	50	27	nil	
ditto	32	138	nil	
arenarium, Labill.	48	58	nil	
ditto	59	58	nil	
australe, D. C.	57	30	nil	
parisiense, Linn., var. anglicum.	14	62	nil	
ditto	many		some	Michalet. In soil
ditto	52	3000	nil	
pedemontanum, All.	50	180	nil	
rubioides, Linn.	50	23	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
saxatile, L.	46	65	nil	
ditto	50	85	nil	
ditto	100?		few	Peter. Supp. age in soil.
spurium, L.	15	20	nil	A. de C.
sylvaticum, L.	70	130	nil	
sylvaticum, L., var. capillipes,	50	51	nil	
tricorne, Stokes.	17	94	nil	
ditto	20?		few	Peter. Supp. time in soil.
ditto	55	110	nil	
Gardenia, sp.	20	210	nil	
Garuleum viscosum, Cass.	15	20	nil	A. de C.
Gastridum australe, Beauv., Gard., var. lendigerum.	62	100	nil	
Gaultheria hispida, R. Br.	57	400	nil	
Gaylussacia dumosa, Torr. and Gray.	57	28	nil	
Geitonoplesium cynosum, A. Cunn.	57	82	nil	
Genista aethnensis, D. C.	50	12	nil	
anglica, L.	42	9	nil	Sw. in water.
		10	20	Sw. after 1 hr. in acid.
ditto	74	15	nil	Sw. after 1 hr. in acid.
hispanica, L.	50	11	nil	
pilosa, L.	50	18	nil	
radiata, Scop.	50	7	nil	
Spachiana, Webb.	51	82	2.4	Sw. after long soaking.
ditto	88	20	nil	
virgata, Link.	50	6	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Gentiana asclepiadea, Linn.	15	20	nil	A. de C.
montana, Forst. f.	53	125	nil	
Geococcus pusillus, J. Drum.	10	100	nil	
ditto	15	300	nil	
ditto	18	100	nil	
ditto	20	200	nil	
ditto	23	100	nil	
ditto	31	100	nil	
Geranium asphodeloides, Burm., var. nemorosum, Tenore	50	17	nil	
dissectum, L., var. parviflorum.	57	10	nil	
dissectum, L., var. pilosum.	57	50	nil	
dissectum, L., var. potentilloides.	54	50	nil	28 sw. in water, rest after ½ hr. acid
lucidum, L.	50	73	nil	
molle, L.	59	48	nil	
pyrenaicum, Burm. f.	55	62	nil	
sessiliflorum, Cav., var. brevicaule.	57	50	nil	
Gerardia quercifolia, Pursh.	50	100	nil	
Geum coccineum, Sibth. and Sm.	50	53	nil	
coccineum, var. splendens.	fresh		many	D. After 36 days in sea water.
ditto	fresh		1	D. After 70 days in sea water.
Gilia capitata, Sims.	50	32	nil	
micrantha, Steud.	50	80	nil	
multicaulis, Benth.	50	225	nil	
ditto, var. millefoliata.	50	130	nil	
squarrosa, Hook. and Arn.	20	50	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	18	100	nil	
tricolor, Benth.			nil	Berkeley. After 30 days in sea water.
Ginkgo biloba, Linn.			some	Mart. After 45 days floating on sea water.
Glaucium corniculatum, Curt.	50	62	nil	
flavum	50	180	nil	
flavum, Crantz., var. luteum, Scop.	14	250	nil	
ditto	1000		some	White. Supp. age in soil.
Serpieri, Weldr.	1500		some	V. Heldreich. Supp. age in soil.
Glyceria aquatica, Wahlenb.	57	500	nil	
ditto	67	1000	nil	
fluitans, R. Br.	55	100	nil	
Hookeriana, F. v. M.	57	81	nil	
ramigera, F. v. M.	57	60	nil	
Glycine clandestina, Wendl.	37	4	nil	
Soja, Zich. et Zucc. (Sojabean).	2	100*	50	Vilmorin. Ext. limit, 6 yrs.
ditto	50	82	nil	
ditto	10	50	nil	
tabacina, Benth.	50	30	nil	
Gmelina Leichardtii, F. v. M.	15	21	nil	
Gnaphalium japonicum, Thunb., var. involucratum.	50	250	nil	
purpureum, Linn.	67	250	nil	
supinum, L.	56	50	nil	
sylvaticum, L.	12	250	nil	
ditto	15	20	nil	A. de C.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	18?		few	Peter. Supp. age in soil.
ditto	50	500	nil	
uliginosum, L.	16	250	nil	
ditto	18?		some	Peter. Supp. age in soil.
ditto	35?		many	Peter. Supp. age in soil.
ditto	36?		few	Peter. Supp. time in soil.
ditto	45?		few	Peter. Supp. time in soil.
ditto	77	1200	nil	
ditto	53	1500	nil	
ditto	100?		some	Peter. Supp. time in soil.
Gnetum Gnemon, L.			some	Hemsley. After months in sea water.
Goldbachia laevigata, D. C., var. torulosa.	12		nil	Nobbe.
Gompholobium latifolium, Sm.	12	100	22	2 hr. in acid.
ditto	22	80	5	Sw. after 2 hr. in acid.
ditto	59	63	nil	
minus, Sm., var. tetrathecoides, Sieb.	50	11	nil	Sw. in water.
ditto	50	38	5.2	After 1 hr. in acid.
ditto	64	50	2	Sw. after 1 hr. in acid.
Goodenia cycloptera, R. Br.	57	110	nil	
heteromera, F. v. M.	57	43	nil	
pinnatifida, Schlecht.	57	80	nil	
varia, R. Br.	57	80	nil	
Goodia lotifolia, Salisb.	8	50	84	2 hr. in acid, 10 sw. in water, 9 germ.; after a second 2 hr. in acid 40 sw. and 32 germ.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	51	19	10.5	After 2 hr. in acid.
ditto	57	220	45	58 sw. in water without filing. Of these 11 germ. After slight filing, 10 sw. and 7 germ. Remaining 152 in acid for 1hr.; all sw. and 74 germ.
ditto	105	26	7.7	16 sw. and decayed; 10 sw. and, after filing, 2 germ. (Coll. by R. Brown.)
lotifolia, Salisb., var. medicaginea.	50	16	25	After 3 hr. in acid.
ditto	57	8	nil	Sw. in water.
ditto	57	10	30	Sw. after 6 hr. in acid.
ditto	59	20	5	Sw. in water.
ditto	59	27	30	Sw. after 6 hr. in acid.
Gossypium herbaceum, L.	10	8	nil	
herbaceum, L., var. hirsutum, L.	1	77.5*	72	Duvel. Of buried seed none germ.
Sturtii, F. v. M.	10	28	80	2 sw. and germ. after soaking. Rest sw. after 1 hr. in acid and 14 germ.
ditto	22	28	14	Sw. after 1 hr. in acid.
Gramineae.	25		nil	Becquerel.
Grevillea alpina, Lindl., var. Dallachiana.	50	12	nil	
ditto	57	29	nil	
australis, R. Br.	57	44	nil	
Caleyi, R. Br.	57	30	nil	
ericifolia, R. Br., var. Latrobei.	50	80	nil	
Kennedyana, F. v. M.	10	45	nil	
robusta, A. Cunn.	8	30	nil	
robusta, A. Cunn.	57	22	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Grindelia squarrosa, Dunal.	1	26*	41	Duvel. Buried deeply, 42 per cent germ.
Guizotia abyssinica, Cass., var. oleifera.	13	200	nil	
ditto	47	30	nil	
ditto	50	28	nil	
Gunnera chilensis, Lam., var. scabra.	50	12	nil	
Gypsophila scorzonerifolia, Ser.	15	20	nil	A. de C.
Haematoxylon campechianum, L.	8	18	nil	
Hakea acicularis, Knight.	50	18	nil	
ditto, var. brachyrrhyncha.	32	46	nil	
ditto	51	2	nil	
bipinnatifida, R. Br.	50	14	nil	
cycloptera, R. Br.	10	5	60	
gibbosa, Lav.	50	13	nil	
lissocarpha, R. Br.	30	14	nil	
microcarpa, R. Br.	57	20	nil	
microcarpa, R. Br., var. bifrons.	57	13	nil	
nodosa, R. Br.	37	20	nil	
nodosa, R. Br., var. flexilis, R. Br.	57	7	nil	
ditto	54	10	nil	
pugioniformis, Cav.	57	7	nil	
rostrata, F. v. M.	50	20	nil	
ditto	57	20	nil	
saligna, Knight.	57	14	nil	
subsulcata, Meissn.	41	14	nil	
ulicina, R. Br.	55	20	nil	
ulicina, R. Br., var. carinata.	57	12	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	50	40	nil	
undulata, R. Br.	50	13	nil	
vittata, R. Br.	55	15	nil	
Haloragis acutangula, F. v. M.	57	62	nil	
glauca, Lindl.	57	20	nil	
mucronata, Benth.	57	100	nil	
odontocarpa, F. v. M.	57	84	nil	
Hardenbergia monophylla, Benth.	50	27	18.5	10 unsw. after 5 months in soil. Of these 5 germ. after filing.
monophylla, Benth., var. alba.	51	13	15.4	3 unsw. after 5 m. in soil. Of these 2 germ. after a week's soaking in water at 30-40 deg. C.
Harpullia, sp.?	47	20	nil	
pendula, Planch	16	20	nil	
Hebenstretia dentata, L.	50	240	nil	
Hedycarya angustifolia, A. Cunn., var. Pseudo-morus, Forst.	50	47	nil	
ditto	57	42	nil	1 hr. in acid.
ditto	57	42	nil	Kept moist 10 weeks.
arborea, Forst., var. dentata.	47	70	nil	
Hedysarum elongatum, Fisch.	50	19	nil	
Helianthemum canadense, Michx.	67	200	nil	
glaucum, Pers., var. croceum.	50	11	nil	
guttatum, Mill.	50	400	nil	
oelandicum, Wahlenb., var. marifolium, Bess.	50	30	nil	

	Years old.	No. of Seeds.	Per cen Germ.	
polifolium, D. C., var. hyssopifolium, Tenore.	50	15	nil	
ditto, var. roseum.	50	12	nil	
salicifolium, Mill.	15	20	nil	A. de C.
vulgare, Gaertn, var. serpyllifolium.	50	30	nil	
Helianthus annuus, L. (Sunflower).	fresh	100	33	1 h. at 100 deg. C., dry.
ditto	1	97*	96.5	Duvel. Buried, all died.
ditto	1	100	97	Duvel. Buried deeply, 66 per cent.
ditto	15	20	nil	A. de C.
ditto	50	14	nil	
ditto	fresh	100	51	Des. 42 days at 37 deg. C.
ditto	51	500	nil	
californicus, D. C.	50	27	nil	
pubescens, Rafin.	15	20	nil	A. de C.
strumosus, Linn.	67	86	nil	
Helichrysum adnatum, Benth.	50	320	nil	
baccharoides, F. v. M.	57	300	nil	
bracteatum, Andr.	50	90	nil	
cinereum, F. v. M.	57	2000	nil	
cuneifolium, F. v. M.	57	1000	nil	
diosmaefolium, Sweet.	15	160	nil	
ditto	57	850	nil	
lucidum, Henckel.	10	800	nil	
pholidotum, F. v. M.	57	1000	nil	
reticulatum, Less.	57	250	nil	

	Years old.	No. of Seeds	Per cent. Germ.	
semipapposum, D C.	57	220	nil	
subulifolium, Harv.	6	100	44	
ditto	22	100	nil	
Heleiocharis ovata, R. Br.	many		some	Sirodot. In soil.
ditto	18	250	nil	
ditto	57	110	nil	
ditto	43	50	nil	
Heliotropium europaeum, L., var. vulgare.	18	200	nil	
ditto	24	150	nil	
ditto	1400?		some	Des Moulins. Seed from a Roman tomb.
Helipterum dimorpholepis, Benth.	37	200	nil	
incanum, D. C., var. albicans.	10	250	4.8	
roseum, Benth.	10	300	5	
ditto	7	140	5	
ditto	17	150	nil	
ditto	50	40	nil	
ditto	50	280	nil	
Heracleum candicans, Wall.	50	15	nil	
Heritiera littoralis, Ait.			some	Hemsley. Many m. fl. on sea water.
Hermannia angularis, Jacq.	51	200	23	Within 5 months, without filing.
denudata, Linn. f.	70	20	nil	
ditto	83	50	nil	
Gerardii, Harv.	16	56	nil	All sw. in water.
hyssopifolia, L.	46	120	nil	
Sandersonii, Harv.	12	68	2	Sw. in water.
Herniaria glabra, L.	55	140	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
vulgaris, Spreng.	15	20	nil	A. de C.
Hesperis fragrans, Fisch.	50	20	nil	
Hibiscus brachysiphonius, F. v. M.	57	25	nil	
cannabinus, L.	59	120	nil	All sw. in water.
coccineus, Watt., var. speciosus.			some	Thuret. After 13 d. fl. on sea water.
diversifolius, Jacq.	41	75	nil	Sw. in water.
		12	nil	Sw. after $1\frac{1}{4}$ hr. in acid.
esculentus (Okia), L.	5	100*	50	Vilmorin. Ext. limit, 10 yrs.
ditto	10	40	20	
ditto	12		nil	Nobbe.
heterophyllus, Vent.	10	18	39	Sw. in water.
		72	39	Sw. after 1 hr. in acid.
Manihot, Linn.	fresh		nil	Berkeley. After 11 days in sea water.
militaris, Cav.	1	98*	92	Duvel. Buried; all died.
panduraeformis, Burm. f.	16	17	nil	Sw. in water.
		95	2	Sw. after 1 hr. in acid.
ditto	46	160	nil	All. sw. in water.
rhodopetalus, F. v. M.	25	13	nil	Sw. in water.
		32	nil	Sw. after 1hr. in acid.
spathulatus, Gaudich.	50	85	nil	
suranensis, L.	58	29	nil	All sw. in water.
syriacus, L.	29	33	nil	All sw. in water.
tiliaceus, L.			some	Lefroy. After months on sea water.
ditto	14	100	5	Sw. after 2 hr. in acid.
ditto	25	36	nil	All sw. in water.
Trionum, L.	16	31	nil	Sw. in water.
		18	12	Sw. after 1 hr. in acid.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	51	40	5	After 5 m. soil, and warm water 1 week.
ditto	57	52	12	All sw. after 1 hr. in acid.
ditto	61	28	nil	Sw. in water.
ditto	61	78	8	After 2 hr. in acid.
ditto	70	90	1	Sw. in water of 119 seeds.
		3	nil	Sw. after 2 hr. in acid.
		8	25	Sw. after 4 hr. in acid.
		18	33	Sw. after 10 hr. in acid.
ditto	72	18	nil	Sw. in water.
		58	nil	Sw. after $\frac{3}{4}$ hr. in acid.
Hicksbeachia pinnatifolia, F. v. M.	15	16	nil	
Hieracium Auricula, L.	12	250	nil	
ditto	32?		few	Peter. Supp. age in ground.
gothicum, Fries.	55	110	nil	
Pilosella, L.	10	300	nil	
ditto	32?		few	Peter. Supp. age in ground.
tomentosum, All., var. verbascifolia, Pers.	50	110	nil	
umbellatum, L.	55	62	nil	
Hippomarathrum cristatum, Boiss.	57	40	nil	
Holcus lanatus, L.	fresh		39	Nobbe.
ditto	3		28	Nobbe.
ditto	18	250	nil	
ditto	45?		few	Peter. Supp. time buried.
ditto	54	150	nil	
mollis, L.	57	150	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Holosteum umbellatum, Linn.	12	180	nil	
ditto	36?		few	Peter. Supp. time in soil.
Homalanthus Leschenaultianus, A. Juss.	57	15	nil	
Hordeum maritimum, With.	68	145	nil	
murinum, L.	57	100	nil	
vulgare, L., var. sativum (Barley)	fresh		many	D. After 28 days in sea water.
ditto			nil	D. After 42 days in sea water.
ditto	fresh	100	53	After 14 d. in ster. oxygenless water.
ditto	fresh	100	26	After 70 d. in ster. oxygenless water.
ditto	fresh	100	18	After 98 d. in ster. oxygenless water.
ditto	fresh	100	44	5 days in oxygenless water.
ditto	fresh	100	6	14 days in oxygenless water.
ditto	fresh	100	nil	21 days in oxygenless water.
ditto	fresh	100	nil	1 day in aqueous $HgCl_2$.
ditto	many		many	Salter. In mud under sea water.
ditto	fresh	100	nil	11 days in 50 per cent. alc.
ditto	fresh	100	45	14 days in abs. alc.
ditto	fresh	100	6	35 days in abs. alc.
ditto	fresh	100	nil	49 days in abs. alc.
ditto	fresh		some	Schroder. Des. to 2 per cent. water.
ditto	fresh	100	84	After 5 weeks in dry H. and N.
ditto	fresh	100	57	Des. 42 days at 37 deg. C.
ditto	fresh	100	72	1 day at 100 deg. C., dry.
ditto	$\frac{1}{4}$	5	100	A. de C. Under Mercury.
ditto	2	10	20	Rom. Air dried.
ditto	2	10	40	Rom. In vacuo.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	2	10	40	Rom. 1 yr. in H, O, N, or water vapour.
ditto	2	10	10	Rom. 1 yr. in CO.
ditto	2	10	30	Rom. 1 yr. in $CHCl_3$ vapour.
ditto	2	10	60	Rom. 1 yr. in ether vapour.
ditto	1	100*	98	Duvel. Buried, all died.
ditto	2		most	Rohde.
ditto	1	100	100	Burgerstein. Dry in air.
ditto	4	100	96	
ditto	7	100	95	
ditto	8 to 10	50	20	From Vict. Dept. of Agric.
ditto	10	100	95	
ditto	10	100	52	Haberlandt.
ditto	12		nil	Wiesner.
vulgare, Linn, var. nepalense.	15	20	nil	A. de C.
ditto	6	21	nil	
ditto	17	45	nil	
ditto	18	38	nil	
vulgare, Linn., var. nigrum.	14	20	nil	
Houstonia purpurea, Linn.	67	88	nil	
Hovea heterophylla, A. Cunn.	37	2	100	2 hr. in acid.
ditto	45	15	33	Sw. after 2 hr. in acid
linearis, R. Br.	54	25	24	2 hr. in acid.
ditto	105	12	17	Sw. after 3 hr. in acid
longifolia, R. Br.	12	60	6.6	$3\frac{1}{2}$ hr. in acid.
ditto	16	1	nil	Sw. in water.
		5	80	3 hr. in acid.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	54	30	nil	All sw. in water. Unripe.
ditto	50	22	9	Sw. after 3 hr. in acid.
longifolia, R. Br., var. lanceolata.	16	16	56.2	3 hr. in acid.
Howittia trilocularis, F. v. M.	57	60	nil	
Huanaca hydrocotylea, F. v. M.	57	53	nil	
Humea cassinacea, F. v. M.	50	330	nil	
Humulus Lupulus, L. (Hop.).	50	140	nil	
ozothamnoides, F. v. M.	2	100*	50	Vilmorin. Ext. limit, 4 yrs.
Hydrocotyle asiatica, L.	57	65	nil	
asiatica, L., var. cordifolia, Hook.	54	16	nil	
geranifolia, F. v. M.	57	72	nil	
hirta, R. Br.	57	100	nil	
laxiflora, de C.	37	45	nil	
vulgaris, L.	59	80	nil	
Hymenanthera Banksii, F. v. M.	57	50	nil	
Hymenosporum flavum, F. v. M.	10	60	nil	
Hyoscyamus Senecionis, Willd.	15	20	nil	A. de C.
Hypericum Androsaemum, L.	25	2000	nil	
ditto	35	1500	nil	
ditto	50	500	nil	
ditto	59	100	nil	
ditto	70	850	nil	
elatum, Ait.	15	20	nil	A. de C.
Elodes, Huds.	57	124	nil	
grandifolium, Choisy.	50	210	nil	
hirsutum, L.	26	500	nil	

	Years old.	No. of Seeds.	Per cent. Germ.		
ditto	50	1000	nil		
ditto	100?		few	Peter.	Supp. age in ground.
humifusum, L.	16	300	nil		
ditto	18	550	nil		
ditto	18?		many	Peter.	Supp. age in soil.
ditto	35?		few	Peter.	Supp. age in soil.
ditto	50	600	nil		
ditto	85	150	nil		
ditto	66	280	nil		
ditto	61	150	nil		
ditto	30	250	nil		
ditto	100?		few	Peter.	Supp. age in soil.
linearifolium, Vahl.	55	110	nil		
montanum, L.	55	140	nil		
perforatum, Linn.	12	5000	nil		
ditto	13	1200	nil		
ditto	15	20	nil	A. de C.	
ditto	20?		few	Peter.	Supp. age in soil.
ditto	36?		many	Peter.	Supp. age in soil.
ditto	45?		few	Peter.	Supp. time buried.
ditto	50	110	nil		
ditto	69	580	nil		
ditto	100?		some	Peter.	Supp. age in ground.
virginicum, Linn.	67	250	nil		
Hypocalymma robustum, Schau.	10	500	nil		
ditto	8	250	nil		

	Years old.	No. of Seeds.	Per cent. Germ.	
Hypochoeris radicata, Linn.	14	250	nil	
ditto	18?		few	Peter. Supp. age in soil.
ditto	23	140	nil	
Hyptis radiata, Willd.	15	20	nil	A. de C.
Hyssopus officinalis, Linn.	15	20	nil	A. de C.
officinalis, Linn. (Hyssop.).	3	100*	50	Vilmorin. Ext. limit, 5 yrs.
Iberis amara, var. Forestieri	50	27	nil	
pinnata, L., var. crenata.	15	20	nil	A. de C.
umbellata, L.	50	88	nil	
Ilex canadensis, Poir.	57	12	nil	
verticillata, Gray.	57	61	nil	
ditto	57	56	nil	
Impatiens Balsamina, Linn	15	20	5-15	A. de C.
ditto.	50	42	nil	
noli-me-tangere, Linn.	5	100	68	
ditto	50	34	nil	
Indigofera australis, Willd.	32	250	35.2	In acid 1 hr., all sw.
ditto	50	32	9	Sw. after 1 hr. in acid.
ditto	57	50	6	In acid 1 hr.
australis, Willd., var. Signata.	54	42	nil	Sw. in water.
australis, Willd, var. sylvatica.	50	54	nil	
		58	5.2	After 2 hr. in acid.
ditto	51	54	3.7	6 unswollen after 5 months. Germ. after 1 week in warm water at 40 deg. C.
cytisoides, L.	51	160	51.2	After 5 months in soil, 35 hard, unswollen. Of these 34 germ. on filing.

	Years old.	No. of Seeds.	Per cent Germ.	
ditto	81	40	5	Sw. after 2 hr. in acid.
tinctoria, Linn. (Indigo).	9	250	2	
ditto	6	500	3	
Inula crithmoides, L.	56	50	nil	
Helenium, L. (Elecampane).	5	100*	50	Vilmorin. Ext. limit, 6 yrs.
Iochroma tubulosa, Benth.	50	100	nil	
Ipomaea biloba, Forst., var. pes-caprae, Benth.	fresh		some	Moseley. 1 yr. in sea water.
eriocarpa, R. Br.	10	24	33.3	
grandiflora.	fresh		some	Guppy. After 1 yr. on sea water.
lacunosa, Linn.	1	98	88	Duvel. Buried deeply, 33 per cent.
purpurea, Rath.	50	29	nil	
Iris, sp.	18		some	Foster. Gard. Chron., 1907.
dichotoma, Pall.	15	20	nil	A. de C.
Pseudacorus, Linn.	1		some	Guppy. After 14 months in sea water.
Xiphium, Linn.	15	20	nil	A. de C.
Isachne australis, R. Br.	54	100	nil	
Isatis tinctoria, L.	59	68	nil	
Isopogon anethifolius, Knight	10	1000	nil	
ceratophyllus, R. Br.	47	33	nil	
Dawsoni, Maiden and Baker.	10	100	nil	
Isopyrum biternatum, Torr. and Gray.	67	53	nil	
fumarioides, L	50	38	nil	
Isotoma axillaris, R. Br.	50	180	nil	
ditto	54	250	nil	
Ixia polystachya, Linn., var. erecta, Berg.	50	180	nil	

	Years old.	No. of Seeds.	Per cent Germ	
Ixiolaena tomentosa, Sond. and Muell.	57	320	nil	
Ixodia achilleoides, Ait., var. alata.	57	100	nil	
Jacksonia compressa, Turcz.	67	50	nil	Sw. in water.
Forrestii, F. v. M.	28	22	nil	Sw. in water.
hakeoides, Meissn.	30	60	nil	Sw. in water.
spinosa, R. Br.	72	27	3.7	After long soaking, and for weeks at 25 deg. C. appr.
thesioides, A. Cunn.	29	50	36	½ sw., none germ. Rest ½ hr. in acid. All sw. and 18 germ.
ditto	52	12	nil	Sw. after ½ hr. in acid.
vernicosa, F. v. M.	57	12	nil	
Jasione montana, L.	55	2000	nil	
Juncaceae.	25	-	nil	Becquerel.
Juncus acutus, L.	55	2000	nil	
balticus, Willd.	57	88	nil	
bufonius, L.	12	150	nil	
ditto	18?	-	many	Peter. Supp. age in soil.
ditto	22	280	nil	
ditto	35?	-	some	Peter. Supp. age in soil.
ditto	57	500	nil	
ditto	100?	-	many	Peter. Supp. age in soil.
ditto	2000?	-	some	Poisson. In soil.
ditto	30	-	nil	Becquerel.
caespiticius, E. Meyer.	55	1000	nil	
effusus, L., var. conglomeratus, L.	14	250	nil	
ditto	18?	-	few	Peter. Supp. age in soil.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	35?		few	Peter. Supp. age in soil.
ditto	50	200	nil	
ditto	100?		many	Peter. Supp. age in soil.
effusus, L.	57	1000	nil	
falcatus, E. Meyer.	57	1000	nil	
filiformis, L.	50	500	nil	
ditto	100?		few	Peter. Supp. age in soil.
glaucus, Sibth.	25	150	nil	
ditto	32?		few	Peter. Supp. age in ground.
ditto	45?		many	Peter. Supp. time buried.
ditto	50	250	nil	
ditto	100		many	Peter. Supp. age in ground.
Holoschoenus, R. Br., var. humilis.	57	1000	nil	
maritimus, Lam.	54	1000	nil	
pallidus, R. Br., var. vaginatus.	57	1000	nil	
pauciflorus, R. Br.	57	500	nil	
planifolius, R. Br.	57	150	nil	
scirpoides, Lam.	57	140	nil	
Tenageia, Ehrb.	66	1000	nil	
ditto	105	250	nil	
ditto	58	5000	nil	
ditto	67	1000	nil	
ditto	48	500	nil	
ditto	many		some	Poisson. In soil.
Juniperus communis, L.	59	48	nil	
ditto	55	88	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Kalmia angustifolia, Linn.	50	100	nil	
angustifolia, Linn., var. Lucida Linn.	50	400	nil	
angustifolia, Linn., var. nitida.	50	350	nil	
angustifolia, Linn., var. serotina.	50	300	nil	
glauca, Ait.	50	250	nil	
latifolia, Linn.	50	200	nil	
latifolia, Linn., var. myrtifolia, Andr.	50	200	nil	
Kennedya Beckxiana, F. v. M.	8	11	nil	
monophylla, Vent.	16	12	50	2 hr. in acid.
ditto	50	25	15	2 hr. in acid.
prostrata, R. Br.	12	50	62	3 hr. in acid.
ditto	50	48	8	3 hr. in acid.
rubicunda, Vent.	7	28	71.4	2 hr. in acid.
ditto	12	100	28	2 hr. in acid.
ditto	57	2	nil	Sw. in water.
		20	70	2 hr. in acid.
ditto	65	18	10	After 2 hr. in acid.
ditto	50	12	nil	
Kibara macrophylla, Benth.	12	31	nil	
Kitaibelia vitifolia, Willd.	15	20	5-15	A. de C.
ditto	50	18	nil	
ditto	50	24	nil	
Kochia appressa, Benth.	20	50	nil	
brachyptera, F. v. M.	57	200	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
brevifolia, R. Br.	51	30	nil	
villosa, Lindl.	53	50	nil	
Krynitzkia, leiocarpa, Fisch. and Meyer.	50	64	nil	
leucophaea, A. Gray.	50	160	nil	
Kydia calycina, Roxb.	10	80	28.7	After 2 hr. in acid, all sw.
ditto	50	18	nil	Sw. after 2 hr. in acid.
Labichea lanceolata, Benth.	12	50	2	Large aril absorbs water, but not the seed.
ditto	50	48	nil	Cuticle frills off after filing, or is dissolved by 2 hr. in acid.
Laburnum anagyroides, Medic.	15	20	nil	A. de C.
Lactuca perennis, L.	3	100*	50	Vilmorin. Ext. limit, 5 yrs.
Scariola, Linn.	1	25	11.5	Duvel. Buried deeply, 69 per cent.
Scariola, Linn., var. sativa.	1	100*	98.5	Duvel. None germ. after 1 yr. buried.
Scariola, L., var. sativa (Lettuce).	5	100*	50	Vilmorin. Ext. limit, 9 yrs.
Scariola, Linn., var. sativa.	fresh	20	35	D. After 56 days in sea water.
	fresh	20	1	D. After 85 days in sea water.
Scariola, Linn., var. sativa (Lettuce Neapolitan).	10	250	nil	
Lagenaria vulgaris, Ser. (Bottle gourd).	6	100*	50	Vilmorin. Ext. limit, 10 yrs.
Lagenophora Huegelii, Benth.	57	105	nil	
Lagerstroemia lanceolata, Wall.	10	42	nil	
Lallemantia peltata, Fisch. and Meyer.	50	48	nil	
Lamium Galeobdolon, Crantz.	16	58	nil	
ditto	100?		few	Peter. Supp. age in ground.
intermedium, Fries.	55	90	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Lantana involucrata, Linn.	15	20	nil	A. de C.
mista, Linn., var. mixta, Hort.	50	11	nil	
Sellowiama, Link. and Otto.	6	16	nil	
Lodoicea sechellarum, Labill.				Trimen. Nut takes 10 yrs. to ripen, and seed 1 yr. to germinate.
Laportea crenulata, Gaudich.	40	55	nil	
Lapsana communis, Linn.	16	250	nil	
ditto	18?		few	Peter. Supp. age in soil.
Lasthenia glabrata, Lindl.	50	44	nil	
ditto			some	Berkeley. After 30 days in sea water.
Lathyrus Aphaca, L.	55	20	nil	All sw. in water.
articulatus, Linn.	50	56	nil	
articulatus, Linn., var. Cicera, All.	15	20	nil	A. de C.
hirsutus, L.	51	50	nil	
hirsutus, Linn., var. Cicer, Habl.	50	16	nil	
latifolius, Linn.	50	52	nil	
maritimus, Bigel.	34	44	nil	All sw. in water.
ditto	54	5	nil	Sw. in water.
		44	nil	Sw. after 1 hr. in acid.
ditto	50	17	nil	
Nissolia, Linn.	many		some	Poisson. In soil.
ditto	25	58	nil	
ditto	46	37	nil	All sw. in water.
Ochrus, D. C.	46	15	nil	All sw. in water.
odoratus, Linn.	50	12	nil	
palustris, L., var. graminifolius.	20	66	nil	Sw. in water.

	Years old.	No. of Seeds.	Per cent. Germ.	
sativus, L.	5	100	50	Vilmorin.
tingitanus, L.	50	72	nil	
Lavandula coronopifolia, Poir., var. multifida.	15	20	nil	A. de C.
vera, D. C.	5	100	50	Vilmorin. Ext. limit, 6 yrs.
Lavatera arborea, Linn.	15	20	5-15	A. de C.
ditto	55	100	nil	All sw. in water.
ditto	59	84	nil	Sw. in water.
ditto	50	42	nil	
cretica, Linn.	15	20	30	A. de C.
ditto	50	46	nil	
Julii, Burch.	74	40	nil	All sw. in water.
olbia, L.	63		some	Becquerel.
plebeia, Sims.	13	170	28.2	$1\frac{1}{2}$ hr. in acid.
ditto	18	100	7	$1\frac{1}{2}$ hr. in acid.
ditto	50	68	nil	Sw. after 1 hr. in acid.
ditto	54	50	nil	28 sw. in water, rest after 1 hr. in acid.
Leycesteria formosa, Wall.	50	24	nil	
Lemna minor, Linn.			nil	Guppy. After a few days in sea water.
Lens esculenta, Moench.	4	100*	50	Vilmorin. Ext. limit, 9 yrs.
ditto.	64		some	Becquerel.
esculenta, Moench., var majus.	50	41	nil	
esculenta, Moench., var. minus.	50	26	nil	
Leonurus Cardiaca, L	15	1000	nil	
ditto	50	108	nil	
Leontodon hispidus, L.	14	200	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	36?		few	Peter Supp. time in soil.
ditto	38	55	nil	
Lepidium campestre, Ait.	12		nil	Nobbe.
ditto	17	210	nil	
ditto	50	24	nil	
ditto	61	41	nil	
ditto	300		nil	Nobbe. Old Herb.
draba, Linn.	50	64	nil	
ditto	62	45	nil	
hirtum, Sm., var. Smithii.	50	120	nil	
ditto.	61	90	nil	
leptopetalum, F. v. M.	47	38	nil	
monoplocoides, F. v. M.	57	200	nil	
papillosum, F. v. M.	57	110	nil	
perfoliatum, L.	50	210	nil	
ruderale, L.	41	200	nil	
ruderale, Linn., var. hyssopifolium.	57	82	nil	
ditto	58	100	nil	
ditto	64	116	nil	
sativum, L. (Cress).	fresh	57	10	D. After 56 days in sea water.
ditto			2	D. After 85 days in sea water.
ditto	fresh	60	6	D. After 65 days in cold sea water.
ditto	fresh	100	51	3 weeks in abs. alc.
ditto	fresh	100	30	4 weeks in abs. alc.
ditto	fresh	100	nil	5 weeks in abs. alc.
ditto	fresh	100	nil	5 days in 50 per cent. alc.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	2	10	90	Rom. Air dried.
ditto	2	10	80	Rom. 15 m. in vacuo, or 1 yr. in H_2S
ditto	2	10	100	Rom. 1 yr. in O H or N.
ditto	2	10	40-60	Rom. 1 yr. in CO, ether or chloroform vapour.
ditto	2	10	nil	Rom. 1 yr. in aqueous vapour.
ditto	5	100	50	Vilmorin. Ext. limit, 9 yrs.
ditto	10	250	nil	
ditto	51	60	nil	
Lepilaena australis, Drum.	57	75	nil	
Leptocarpus Brownii, Hook. f., var. simplex, R. Br.	57	80	nil	
ditto	57	200	nil	
Leptorrhynchos squamatus, Less.	57	250	nil	
tenuifolius, F. v. M.	57	180	nil	
Waitzia, Sond.	57	182	nil	
Leptospermum flavescens, Sm.	15	1000	nil	
ditto	50	40	nil	
laevigatum, F. v. M.	50	84	nil	
myrtifolium, Sieb.	57	200	nil	
pubescens, Lam., var. grandifolium.	54	2000	nil	
ditto	57	100	nil	
pubescens, Lam., var. lanigerum.	50	280	nil	
ditto	54	500	nil	
rupestre, Hook. f.	57	1000	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
scoparium, Forst.	10	1000	8.2	2 months to complete germ.
ditto	16	500	2.4	3 months to complete germ.
ditto	57	1000	nil	
scoparium, Forst. (juniperinum).	50	45	nil	
ditto	55	500	nil	
Lespedeza capitata, Michx., var. frutescens.	1	15	1	Duvel. Buried in soil, 1 per cent.
violacea, Pers.	47	82	nil	All sw. in water.
ditto	67	110	nil	All sw. in water.
Leucaena glauca, Benth.	15	42	nil	All sw. in water.
ditto	42	24	nil	All sw. in water.
ditto	60	100	nil	All sw. in water.
leucocephala ?	70		some	Becquerel. Name not in Kew Index.
pulverulenta, Benth.	18	7	29	Sw. in water.
ditto		12	42	Sw. after $1\frac{1}{4}$ hr. in acid.
Leucanthemum lacustre, Brot.	50	80	nil	
Leucas martinicensis, R. Br.	15	20	nil	A. de C.
Leucopogon acuminatus, R. Br.	57	30	nil	
Hookeri, Sond.	57	32	nil	
Hookeri, Sond., var. obtusatus.	57	60	nil	
Hookeri, Sond., var. vallinus.	57	22	nil	
insularis, A. Cunn.	57	24	nil	
juniperinus, R. Br.	47	152	nil	
lanceolatus, R. Br.	44	50	nil	
ditto, var. affinis.	57	250	nil	
Maccraei, F. v. M.	54	25	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Richei, R. Br.	57	20	nil	
Levisticum officinale, Koch. (Lovage).	3	100*	50	Vilmorin. Ext. limit, 4 yrs.
Ligusticum apioides, Phil.	15	20	nil	A. de C.
Ligustrum vulgare, Linn.	50	17	nil	
Liliaceæ.	25		nil	Becquerel.
Lilium tigrinum, Ker. Gawl.	50	80	nil	
Limnanthes Douglasii, R. Br.			some	Berkeley. After 30 days in sea water.
Limosella aquatica, L.	30	58	nil	
ditto	50	500	nil	
ditto, var. tenuifolia, Wolf.	57	220	nil	
Linaria Elatine, Mill.	18	120	nil	
ditto	22?		few	Peter. Supp. age in soil.
ditto	59	100	nil	
ditto	61	42	nil	
ditto	71	72	nil	
viscida, Moench.	61	84	nil	
vulgaris, Mill.	16	250	nil	
ditto	20?		few	Peter. Supp. time in soil.
ditto	25	94	nil	
Linum alpinum, L., var. Leonii, Schultz.	49	80	nil	
angustifolium, Huds.	23	190	nil	
ditto	50	160	nil	
ditto	57	93	nil	
austriacum, L.	54	30	nil	
catharticum, Linn.	24	47	nil	
ditto	32?		some	Peter. Supp. age in ground.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	45?		few	Peter. Supp. time buried.
ditto	46?		few	Peter. Supp. time buried.
ditto	59	72	nil	
ditto	100?		few	Peter. Supp. age in soil.
grandiflorum, Desf.	50	24	nil	
maritimum, Linn.			some	Mart. After 45 days on sea water.
mexicanum, H. B. and K.	15	180	nil	
perenne, L.	49	150	nil	
ditto	50	84	nil	
strictum, Linn., var. alternum.	83	30	nil	
usitatissimum, L. (Linseed).			few	D. After 14 days in sea water.
ditto			1	D. After 28 days in sea water.
ditto			nil	D. After 42 days in sea water.
ditto	fresh	100	60	5 days oxygenless water.
ditto	fresh	100	36	14 days oxygenless water.
ditto	fresh	100	nil	21 days oxygenless water.
ditto	fresh	100	nil	1 day aqueous $HgCl_2$.
ditto	fresh	100	72	After 5 weeks in dry H and N.
ditto	fresh	100	20	After 14 days in abs. alc.
ditto	fresh	100	1	After 28 days in abs. alc.
ditto	fresh	100	nil	After 35 days in abs. alc.
ditto	fresh	100	nil	After 1 day in 50 per cent. alc.
ditto	1	93	83	Duvel. None germ. after 1 yr. in soil.
ditto	fresh		46-98	Nobbe.
ditto	4		10-78	Nobbe.
ditto	12		14	Nobbe.

	Years old.	No. of Seeds.	Per cent. Germ.		
ditto	12		nil		
ditto	15	20	nil	A. de C.	
ditto	50	52	nil		
ditto	55	84	nil		
Lippia rubiginosa, Schau.	15	20	nil	A. de C.	
Lithospermum officinale, Linn.	15	20	nil	A. de C.	
Livistona australis, Mart.	8	4	nil		
Lobelia Erinus, Linn.			very	A. de C..	Cooled 100 t. to about 50 deg.
ditto	fresh		few		
gibbosa, Labill.	50	186	nil		
ditto, var. simplicicaulis.	50	2000	nil		
	55	150	nil		
heterophylla, Labill.	50	200	nil		
Lobostemon fruticosus, Buek.	50	41	nil		
Logania crassifolia, R. Br.	57	50	nil		
floribunda, R. Br.	10	100	nil		
ovata, R. Br.	57	100	nil		
Loiseleuria procumbens, Desf.	61	130	nil		
Lolium perenne, L.	55	90	nil		
perenne, L., var. tenue, L.	15	20	nil	A. de C.	
temulentum, L.	15	20	nil	A. de C.	
ditto	55	46	nil		
Lomatia silaifolia, R. Br.	12	80	nil		
Lonas inodora, Gaertn.	50	240	nil		
Lonicera Caprifolium, L., var. proliferum.	50	13	nil		
sempervirens, Linn.	50	14	nil		

	Years old.	No. of Seeds.	Per cent. Germ.	
Quinquelocularis, Hardw.	50	23	nil	
Loranthus Quandong, Lindl., var. canus.	54	20	nil	
Lotus biflorus, Desr.	50	15	nil	
ditto	50	38	nil	
corniculatus, L.	18	140	22	After ¼ hr. in acid.
ditto	50	38	nil	
ditto	57	10	nil	
ditto	100?		few	Peter. Supp. age in soil.
edulis, L.	68	22	nil	
Jacobaeus, Linn.	15	20	nil	A. de C.
Tetragonolobus, L. (Winged Pea).	5	100*	50	Vilmorin. Ext. limit, 9 yrs.
ditto	13	10	20	Embryos sw. slowly within endosperm.
ditto	16	50	4	
ditto	50	23	nil	
ditto	15	13	nil	
Loudonia Behrii, Schl.	57	100	nil	
Lunaria annua, L., var. biennis.	15	20	nil	
rediviva, L.	50	30	nil	
Lupinus albus, L.	fresh	100	94	
ditto	fresh	100	92	Des. 28 days to 1.88 per cent. water.
elegans, H. B. and K., var. moritzianus, Kunth.	50	10	nil	Des. 56 days to 1.28 per cent. water.
hirsutus, L.	50	6	nil	
luteus, L.	fresh	12	33	D. After 22 days in sea water.
ditto		18	17	D. After 36 days in sea water.
ditto			nil	D. After 50 days in sea water.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	50	40	nil	
nanus, Dougl.	50	51	nil	
nanus, Dougl., var. bicolor.	50	8	nil	
polyphyllus, Lindl.	fresh	14	21	D. After 22 days in sea water.
ditto			nil	D. After 36 days in sea water.
ditto	50	18	nil	
pubescens, Benth.			few	Berkeley. After 30 days in sea water.
ditto	50	8	nil	
Termis, Forsk.	12		nil	Nobbe.
versicolor, Sweet.	50	13	nil	
Luzula campestris D. C.	16	200	nil	
ditto	27	500	nil	
ditto	32?		few	Peter. Supp. age in soil.
ditto	35?		few	Peter. Supp. age in soil.
ditto	36?		some	Peter. Supp. age in soil.
ditto	45?		some	Peter. Supp. age in soil.
ditto	100?		few	Peter. Supp. age in soil.
Forsteri, D. C.	60	31	nil	
Forsteri, D. C., var. pilosa.	22	137	nil	
ditto	32?		few	Peter. Supp. age in ground.
ditto	100?		few	Peter. Supp. age in soil.
Lychnis Flos-cuculi, Linn.	50	58	nil	
Githago, Scop.	15	20	nil	A. de C.
ditto	1	99*	98.5	Duvel. None germ. after 1 yr. in soil.
grandiflora, Jacq., var. coronata.	50	140	nil	
viscaria, Linn.	50	210	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Lycium barbarum, L.	50	12	nil	
Lycopersicum esculentum, Mill. (Tomato)	12		20	Nobbe.
ditto			some	Thuret. After 13 m. fl. on sea water.
ditto	4	100*	50	Vilmorin. Ext. limit 10 yrs.
ditto			few	D. After 22 day in sea water.
ditto			nil	D. After 36 days in sea water.
ditto	1	99*	72,5	Duvel. Buried in soil, 1 per cent.
Lycopsis arvensis, L., var. pusillus.	53	131	nil	
Lysimachia atropurpurea, L.	10		some	Meehan. Supp. age in soil.
quadrifolia, L.	57	52	nil	
vulgaris, Linn.	many		some	Salter. 'In mud under sea water.
ditto	15	20	nil	A. de C.
Lythrum Salicaria, L.	57	550	nil	
Macadamia ternifolia, F. v. M.	15	18	nil	
Madia elegans, D. Don	50	22	nil	
sativa, Molina.	15	20	nil	A. de C.
Maianthemum Convallaria, Wigg.	57	16	nil	
Malcolmia maritima, Ait.	15	20	nil	A. de C.
ditto	41	1000	nil	
Mallotus philippinensis, Muell. Arg.	13	60	nil	
Malope trifida, Cav., var. grandiflora.	fresh		some	Berkeley. After 30 days in sea water.
Malva crispa, L. (Curled-leaved Mallow).	5	100*	50	Vilmorin. Ext. limit, 8 yrs.
ditto	52	78	nil	
rotundifolia, L.	10	100	72	All sw. after 3 hr. in acid.
ditto	17	100	8	All sw. after 3 hr. in acid.
ditto	57	30	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
sylvestris, L.	42	156	nil	All sw. in water.
ditto	59	120	nil	All sw. in water.
sylvestris, L., var. vulgaris, Gray.	300		nil	Nobbe. Old Herb.
Malvastrum limense, Ball.	15	20	nil	A. de C.
ditto	50	63	nil	
vitifolium, Hemsl.	15	20	5-15	A. de C.
Marianthus procumbens, Benth.	57	60	nil	
Marrubium astracanicum, Jacq.	15	20	nil	A. de C.
vulgare, L. (Horehound).	3	100*	50	Vilmorin. Ext. limit, 6 yrs.
Marsdenia rostrata, R. Br.	52	40	nil	
Martynia proboscidea, Glox.	1 or 2	100*	50	Vilmorin.
Matthiola incana, R. Br.	16	100	nil	
ditto	15	20	nil	A. de C.
incana, R. Br., var. annua, Sweet.	15	20	nil	A. de C.
ditto			some	D. After 28 days in sea water.
ditto			nil	D. After 54 days in sea water.
Matricaria inodora, Linn.	12	250	nil	
ditto	18?		few	Peter. Supp. age in soil.
Maurandia Barclaiana, Lindl.	50	88	nil	
Medicago arborea, L.	50	42	nil	
denticulata, Willd.	15	20	5-15	A. de C.
ditto	17	100	4	$1\frac{1}{2}$ hr. in acid.
ditto	51	80	nil	
ditto	57	32	nil	All sw. in water. Unripe.
lupulina, Linn.	22?		few	Peter. Supp. age in soil.
ditto	50	82	nil	All sw. in water.

	Years old.	No. of Seeds.	Per cent Germ.	
ditto	50	12	67	Sw. after 1 hr. in acid.
ditto	1400?		nil	Des Moulins. Seed from a Roman tomb.
sativa, L. (Lucerne).			some	Thuret. After 13 months floating on sea water.
ditto	1	84*	64	Duvel. Buried in soil, 9 per cent.
‡ditto	3		50	Giglioli. In air.
ditto	3		63	Giglioli. In dry H.
ditto	3		24	Giglioli. In dry CO_2.
ditto	2		0.5	Giglioli. In NH_3.
ditto	2		4.5	Giglioli. In dry SO_2.
ditto	2		nil	Giglioli. In 60 deg. eth. alc.
ditto	2		23	Giglioli. In 80 deg. eth. alc.
ditto	2		78	Giglioli. In 100 deg. eth. alc.
ditto	3		1.3	Giglioli. In ether.
ditto	3		nil	Giglioli. In chloroform.
ditto	1		1.5	Giglioli. In alc. iodine.
ditto	16	255	70.98	Giglioli. In AsH_3.
ditto	16	247	68.8	Giglioli. In AsH_3.
ditto	16	266	84.2	Giglioli. In CO.
ditto	16	629	0.79	Giglioli. In N_2O_2.
ditto	16		nil	Giglioli. In chloroform.
ditto	16	60	66	Giglioli. In abs. alcohol.
ditto	16	79	20.2	Giglioli. In alc. $HgCl_2$.
ditto	16		nil	Giglioli. In alc. phenol. (not dry).
ditto	16	51	nil	Giglioli. In hydrogen.

‡ If the seeds were at all moist, all were rapidly destroyed in Giglioli's tests.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	16	293	0.68	Giglioli. In oxygen.
ditto	16	320	56	Giglioli. In nitrogen.
ditto	16	342	6.7	Giglioli. In Cl. and HCl.
ditto	16	167	5.9	Giglioli. In Cl. and HCl.
ditto	16	101	0.99	Giglioli. In H_2S.
ditto	11		54	Samek.§
ditto	20	40	nil	All sw. in water.
ditto	50	48	nil	All sw. in water.
ditto	50	10	20	Sw. after 1 hr. in acid.
sativa, Linn., var. media, Pers.	12		12	Nobbe.
scutellata, Mill.	5	100*	50	Vilmorin. Ext. limit 9 yrs.
ditto	7	80	95	70 hard after 1 week soaking. Filed, sw., and 66 germ. in 3 days.
ditto	15	14	43	8 sw. and rotted; 6 unswollen after 3 weeks' soaking, all of which sw. and germ. after sand-papering.
ditto	16	32	3.1	Sw. in water.
		25	8	In acid 2 hr.
ditto	37	100	2	
ditto	70	6	nil	
sphaerocarpa, Bertol.	72	65	nil	10 sw. only after 20 minutes in acid.
truncatula, Gaertn. (Sorrentini).	48	66	nil	
truncatula, Gaertn., var. tribuloides, Desr.	54	16	nil	Sw. in water.
		30	3.3	In acid 2 hr.
Meionectes Brownii, Hook. f.	57	100	nil	

§ Tirol. Landw. Bl., 1894, 13, 161.

	Years old.	No. of Seeds.	Per cent. Germ.	
Melaleuca ericifolia, Sm.	37	250	nil	
ditto	37	150	nil	
linariifolia, Sm.	18	1600	nil	
thymifolia, Sm.	50	2000	nil	
Melampyrum sylvaticum, L.	56	200	nil	
Melanthera deltoidea, Michx.	15	20	nil	A. de C.
hastata, Michx.	50	21	nil	
Melastoma malabathricum, L.	57	350	nil	
Melia Azedarach, Linn.	12	24	nil	
Melianthus major, Linn.	50	21	nil	
minor, Linn.	50	22	nil	
Melica nutans, Linn.	14	80	nil	
ditto	18	27	nil	
ditto	20?		few	Peter. Supp. time in soil.
ditto	55	40	nil	
Melilotus alba, Desr.	44	250	52	24 per cent. germ. after 3 weeks' soaking, ½ still hard. Sand-papered, soaked, and 28 per cent. germ. in 1 week.
ditto	47	1000	67.4	30 germ. in soil, 706 remained hard until sand-papered and soaked at 20-25 deg. C.
ditto	60	1000	22.4	9.2 per cent. sw. and germ. in 2-3 days.
ditto	77	1000	18.2	
alba, Desr., var. altissima, Wall.	38	2000	25.5	5 per cent. germ. after 3 weeks' soaking; over ½ still hard. Sand-papered, sw., and 20.5 per cent. germ. in one week.
ditto	12		nil	Nobbe.

	Years old.	No. of Seeds.	Per cent. Germ.	
Melilotus bicolor, Boiss and Bal.	50	50	nil	
Bonplandi, Tenore.	40	1000	9.8	4 per cent. soaking and 5.8 per cent. or hard seed after scratching and soaking.
gracilis, D. C.	40	1000	36.4	12 germ. in soil. Rest (404) hard after 1 month in soil and 1 week water at 20-25 deg. C. Then sand-papered and swelled.
ditto	50	1000	70.3	24 germ. on soaking, after 1 month in soil; 694 still hard, of which ·97 per cent. germ. after sand-papering.
ditto	51	48	16.6	Germ. after prolonged soaking.
ditto	58	1000	28.8	
ditto	82	410	nil	Sw. in water.
ditto		590	22.5	After 1 hr. in acid.
italica, Lam.	47	100	nil	
messanensis, All.	15	20	nil	A. de C.
ditto	45	100	·1	All sw. without filing.
officinalis, Lam.	15	20	nil	A. de C.
ditto	15	20	nil	A. de C.
ditto	54		some	Becquerel.
officinalis, Lam., var. arvensis.	57	88	nil	All sw. in water.
officinalis, Lam., var. Kochiana.	76	50	nil	
parviflora, Desf.	41	500	16.6.	Began to germ after 2 days. Nearly all sw. without scratching.
ditto	40	1000	4.2	
ditto	51	1000	6.5	3 germ. in soil after 1 month. 64 hard seed germ. after sand-papering.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	50	1000	16.7	1 germ. in soil, rest taken up after 1 m. filed, soaked, and 83 per cent. of remainder (210) germ. at 20-22 deg. C.
ditto	55	40	nil	All sw. in water.
sulcata, Desf.	20	300	nil	
sulcata, Desf. (Pisa Bot. Gard.)	72	80	nil	
ditto	78	100	nil	
Melissa officinalis (Meliss-balm), L.	4	100*	50	Vilmorin. Ext. limit, 7 yrs.
ditto	10	250	nil	
ditto	55	82	nil	
Melothria Muelleri, Benth.	57	29	nil	
Mentha arvensis, L.	19	120	nil	
ditto	25	245	nil	
ditto	45?		few	Peter. Supp. time buried.
laxiflora, Benth.	54	100	nil	
Pulegium, L.	50	110	nil	
Mercurialis annua, Linn.	1400?		some	Des Moulin. Seed from a Roman tomb.
ditto	18	110	nil	
Mesembryanthemum.			some	Thuret. After 13 m. floating on sea water.
acquilaterale, Haw., var. praecox.	57	100	nil	
australe, Soland.	57	100	nil	
crystallinum, L. (Ice Plant).	5	100*	50	Vilmorin.
pomeridianum, Linn.	50	50	nil	
pugioniforme, Linn.	50	180	nil	
Mezoneurum brachycarpum.	15	1	nil	
Scortechinii, F. v. M.	10	15	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Micranthus alopecuroideus, Eckl.	50	22	nil	
Microglossa albescens, C.B. Clarke.	50	80	nil	
Microtis media, R. Br.	55	1000	nil	
porrifolia, R. Br.	37	100	nil	
Milium multiflorum, Cav.	48	100	nil	
Millettia megasperma, Benth.	28	6	nil	
Millotia australis, Benth.	15	6	nil	
caffra, Meiss.	9	8	nil	
tenuifolia, Cass.	55	130	nil	
Mimosa, sp.	67	108	3	Sw. after 1 hr. in acid. Seedlings eaten.
asperata, Linn.	26	62	36	Sw. only after 1 hr. in acid.
biuncifera, Benth.	21	110	nil	All sw. in water.
distachya, Cav.	52		some	Becquerel.
glomerata, Forsk.	52		some	Becquerel.
pudica, L.	fresh		few	de C. Cooled 100 t. to about 50 deg. C.
ditto	60		some	A. P. de Candolle.
sensitiva, L.	fresh		many	D. After 36 days in sea water.
ditto	fresh		many	D. After 50 days in sea water.
tequilana, Wats.	14	80	nil	All sw. in water.
Mimulus gracilis, R. Br.	57	100	nil	
Minuria leptophylla, D. C., var. asteroidea.	47	100	nil	
Mirabilis Jalapa, Linn.	50	10	nil	
Mirbelia oxyloboides, F. v. M.	10	50	38	$1\frac{1}{2}$ hr. in acid.
ditto	16	25	12	$1\frac{1}{2}$ hr. in acid.
reticulata, Sm.	10	20	75	In acid 3 hr.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	26	50	12	In acid 3 hr.
ditto	47	100	3	In acid 3 hr.
ditto	12	37	nil	Sw. in water.
		10	nil	After 1 hr. in acid.
		17	18	After 3 hr. in acid.
Mitrasacme polymorpha, R. Br.	57	40	nil	
pilosa, Labill., var. Stuartii.	57	30	nil	
Modiola multifida, Moench.	50	82	nil	
ditto	15	20	5-15	A. de C.
ditto, var. caroliniana.	50	77	3	
ditto	59	40	nil	
Mollugo oppositifolia, L., var. novo-hollandica.	57	1000	nil	
verticillata, L.	67	300	nil	
Monotoca elliptica, R. Br.	57	50	nil	
Montia fontana, L.	57	63	nil	
Moraea iridioides, Linn.	50	23	nil	
Morgania glabra, R. Br. (B. floribunda).	57	120	nil	
Morina longifolia, Wall.	50	14	nil	
Morinda jasminoides, A. Cunn.	57	14	nil	
Mucuna gigantea, D. C.	11	5	60	8 hr. in acid.
ditto	drift	5	20	Guppy. After 1 yr. in sea water.
pruriens, D. C., var. utilis, Wall.	40	12	nil	
urens, Medic.	5	5	20	Guppy. After 1 yr. in sea water.
ditto	10	3	nil	Sw. after filing.
Muehlenbeckia polygonoides, F. v. M.	57	23	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Myoporum acuminatum, R. Br., var. Cunninghamii, Benth.	50	22	nil	
ditto	57	16	nil	
debile, R. Br., var. diffusum, R. Br.	57	20	nil	
deserti, A. Cunn., var. dulce.	54	20	nil	Filed.
parvifolium, R. Br., var. humile.	37	19	nil	
parvifolium, R. Br.	57	100	nil	
serratum, R Br., var. insulare.	50	51	nil	
ditto	57	37	nil	
Myosotis stricta, Link., var. hispida.	17	88	nil	
ditto	18	125	nil	
ditto	20?		few	Peter. Supp. time buried.
ditto	18?		few	Peter. Supp. age in soil.
ditto	20	170	nil	
Myosurus minimus, L.	57	250	nil	
Myrcia variabilis, D. C.	15	62	nil	
Myrica cerifera, L.	50	30	nil	
Gale, L.	60	200	nil	
Myriogyne orbicularis, Lour.	54	1000	nil	
Myriophyllum spicatum, L.	61	48	nil	
Myrrhis odorata, Scop. (Sweet-scented chervil).	1	100	50	Vilmorin.
Myrsine variabilis, R. Br.	47	30	nil	
ditto	55	34	nil	
Nasturtium indicum, D. C.	15	20	nil	A. de C.
officinale, R. Br. (Water-cress).	5	100*	50	Vilmorin. Ext. limit, 9 yrs.

	Years old.	No. of Seeds.	Per cent. Germ.	
officinale, R. Br.	18	100	nil	
palustre, D. C.	10	150	nil	
ditto	45?		few	Peter. Supp. time buried.
ditto	67	1000	nil	
sylvestre, R. Br.	300		nil	Nobbe. Old Herb.
trifolium, Rchl.	57	250	nil	
Nelumbium luteum, Willd.	55	6	83	Poisson. Air dried.
ditto	55		some	Becquerel.
ditto	57		some	Becquerel.
speciosum, Willd.			some	Mart. After 45 d. floating on sea water.
ditto	17		some	Becquerel.
Nemophila insignis, Benth.			nil	Berkeley. After 30 days in sea water.
parviflora, Dougl.	50	64	nil	
maculata, Benth.			nil	Berkeley. After 30 days in sea water.
Menziesii, Hook. and Arn., var. atomaria.			nil	Berkeley. After 30 days in sea water.
Menziesii, var. discoidalis, Lam.			nil	Berkeley. After 30 days in sea water.
Nepeta botryoides, Ait.	15	20	5-15	A. de C.
Cataria, Linn.	15	3000	3.5	After prolonged soaking.
Nephelium leiocarpum, F. v. M.	57	25	nil	
semicinereum, F. v. M., var. semi-glaucum.	57	40	nil	
tomentosum, F. v. M.	57	25	nil	
Nertera reptans, F. v. M.	57	53	nil	
ditto	57	25	nil	
Neslia paniculata, Desv.	1	96	97	Duvel. Buried deeply, 38.5 per cent.
ditto	15	20	nil	A. de C.

	Years old.	No. of Seeds.	Per cent. Germ.	
Newcastlia spodiotricha, F. v. M.	27	200	nil	
Nicotiana glauca, R. Gratz.	50	150	nil	
glutinosa, Linn.	15	20	nil	A. de C.
rustica, Linn.	50	57	nil	
rustica, Linn., var. asiatica.	15	20	nil	A. de C.
suaveolens, Lehm.	50	200	nil	
Tabacum, L.	1	89	84	Duvel. Buried deeply, 70 per cent.
ditto	30		nil	Becquerel.
ditto	50	1350	nil	
Tabacum, L., var. angustifolia.	50	220	nil	
virginica, Agardh.	10	1000	nil	
Nigella damascena, Linn.	fresh		nil	Kinzel.
ditto	15	20	nil	A. de C.
ditto	50	39	nil	
orientalis, L.	50	14	nil	
sativa, L. (Black cumin).	fresh		nil	Kinzel. Exposed to light at 20 deg. C.
ditto			94	Kinzel. In darkness at 20 deg. C.
ditto	3	100*	50	Vilmorin. Ext. limit, 6 yrs.
Nipa fruticans, Thunb.			some	Chamisso. 1 yr. floating on sea water.
Nolana atriplicifolia, Don	50	32	nil	
ditto, var. grandiflora.			some	Berkeley. After 30 days in sea water.
paradoxa, Lindl.	50	15	nil	
Noltea africana, Reichb.	50	20	nil	
Notelaea ligustrina, Vent.	47	3	nil	
longifolia, Vent.	10	20	nil	
ditto	47	12	nil	

	Years old.	No. of Seeds.	Per cent Germ.	
longifolia, Vent., var. venosa.	57	16	nil	
Nothoscordum fragrans, Kunth.	50	88	nil	
ditto	15	20	nil	A. de C.
Notospartium Carmicheliae, Hook. f.	17	41	nil	Sw. after 1 hr. in acid.
Nymphaea gigantea, Hook.	12	100	22	After 3 days' soaking in warm water.
ditto	16	50	6	After 3 days' soaking in warm water.
Ochrosia Poweri, Bailey.	11	20	5	Endosperm of 2 others showed signs of life, but not the embryo.
Ocimum Basilicum, L. (Sweet Basil).	8	100*	50	Vilmorin. Ext. limit, 10 yrs.
Basilicum, L.	15	20	nil	A. de C.
Basilicum, L., var. maximum.	15	20	nil	A. de C.
Basilicum, L., var. minimum, L.	8	100*	50	Vilmorin. Ext. limit, 10 yrs.
Basilicum, L., var. nigrum, L.	15	20	nil	A. de C.
gratissimum, L. (Tree-basil).	8	100*	50	Vilmorin. Ext. limit, 10 yrs.
sanctum, L.	15	20	nil	A. de C.
Oenanthe Phellandrium, Lam.	15	20	nil	A. de C.
ditto	58	145	nil	
Oenothera acaulis, Cav.	41	250	nil	
acaulis, Cav., var. taraxacifolia.	50	65	nil	
amoena, Lehm.			nil	Berkeley. After 30 days in sea water.
ditto			some	Berkeley. After 30 days in sea water.
biennis, L. (Evening primrose).	1		nil	Duvel. If buried, died.
ditto	15	20	nil	A. de C.
ditto	3	100*	50	Vilmorin. Ext. limit, 5 yr.
ditto	27	38	nil	
ditto	50	180	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
biennis, L., var. grandiflora, Ait.	50	1480	nil	
purpurea, Curt.	50	54	nil	
sinuata, L.	15	20	nil	A. de C.
tetraptera, Cav.	50	210	nil	
tetraptera, Cav., var. mutabilis.	15	20	nil	A. de C.
Olea paniculata, R. Br.	10	35	nil	
verrucosa, Link.	50	13	nil	
Olearia argophylla, F. v. M.	22	100	nil	
ditto	50	124	nil	
glandulosa, Benth.	54	150	nil	
glutinosa, Benth.	54	500	nil	
myrsinoides, F. v. M.	15	250	nil	
pimeleoides, Benth.	14	210	nil	
ditto	57	250	nil	
ramulosa, Benth.	18	100	nil	
ditto	50	60	nil	
stellulata, D. C.	12	100	nil	
stellulata, D. C., var. fulvida, D. C.	50	128	nil	
stellulata, D. C., var. Gunniana, Hook. f.	50	28	nil	
stellulata, var. lyrata, D. C.	50	90	nil	
viscosa, Benth.	12	120	nil	
ditto	57	130	nil	
Omphacomeria acerba, A. de C.	57	15	nil	
Onagraceæ.	25		nil	Becquerel.
Onobrychis Crista-galli, Lam.	5	100*	50	Vilmorin. Ext. limit, 7 yrs.

	Years old.	No. of Seeds.	Per cent. Germ.	
viciaefolia, Scop., var. sativa, Lam.	12		nil	Nobbe.
Natrix, Linn.	15	20	nil	A. de C.
Ononis hispida, Desf.	50	49	nil	
porrigens, Salzm., var. foetida.	50	22	nil	
Onopordon Acanthium, L.	1	95*	31	Duvel. Buried deeply, 93 per cent.
ditto	47	27	nil	
illyricum, Linn.	15	20	nil	A. de C.
tauricum, Willd.	15	20	nil	A. de C.
Opercularia scabrida, Schl.	57	100	nil	
Ophrys apifera, Huds.	55	1500	nil	
Oreomyrrhis andicola, Endl., var. eriopoda, Hook.	55	200	nil	
Origanum Majorana, L. (Sweet marjoram)	3	100*	50	Vilmorin. Ext. limit, 7 yrs.
ditto	50	96	nil	
vulgare, L. (Common marjoram)	5	100*	50	Vilmorin. Ext. limit, 7 yrs.
ditto	42	250	nil	
Orites excelsa, R. Br.	12	15	nil	
Ornithogalum thyrsoides, Jacq.	50	47	nil	
Ornithopus sativus, Brot.	12		nil	Nobbe.
Orobanche major, Linn., var. elatior.	55	100	nil	
Orthoceros strictum, R. Br.	57	500	nil	
Oryza latifolia, Desv.	15	20	nil	A. de C.
sativa, Linn., var. monstrosa.	15	20	nil	A. de C.
Osmorhiza brevistylis, D. C.	67	47	nil	
Osteospermum moniliferum, L.	9	28	nil	
ditto	11	60	nil	Stony covering filed.
ditto	50	13	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Ostrya virginica, Willd.	67	40	nil	
Oxalis microphylla, Phil.	57	100	nil	Sand-paper.
Oxylobium alpestre, F. v. M.	54	24	nil	
Callistachys, Benth.	25	44	82	Sw. only after 1 hr. in acid.
cuneatum, Benth., var. dilatatum.	50	20	5	
ellipticum, R. Br.	20	20	15	Sw. 1 hr. in acid. Cut. frills off.
ditto	63	26	19	1 hr. in acid. Cuticle frills off.
lineare, Benth.	27	60	40	Sw. only after 1¼ hr. in acid.
ditto	30	50	nil	
ditto	41	100	nil	10 min. in acid.
ditto	51	50	20	In 12 weeks, without filing.
ditto	58	50	nil	
parviflorum, Benth.	32	2	nil	Sw. in water.
ditto		21	5	Sw. after 2 hr. in acid.
trilobatum, Benth.	16	10	20	Sw. in water.
		45	35.5	In acid 3 hr.
ditto	49	25	4	Sw. after 1½ hr. in acid.
Oxyria digyna, Hill., var. reniformis.	56	88	nil	
Paliurus aculeatus, Lam.			some	Mart. After 45 days in sea water.
Panax elegans, C. Moore and F. v. M.	12	100	nil	
sambucifolium, Sieber.	57	20	nil	
ditto, var. angustifolius.	54	15	nil	
ditto, var. dendroides.	50	50	nil	
Pancratium maritimum, Linn.			some	Mart. After 45 days in sea water.
Panicum, sp.	50	48	nil	
avenaceum, H. B. and K.	15	20	nil	A. de C.

	Years old.	No. of Seeds.	Per cent. Germ.	
capillare, Linn.	15	20	nil	A. de C.
Crus-galli, Linn.	32	550	nil	
ditto	57	100	nil	
ditto, var. echinatum, Willd.	12		3	Nobbe.
decompositum, R. Br.	57	60	nil	
depauperatum, Muhl.	67	112	nil	
divaricatissimum, R. Br., var. ammophilum.	55	50	nil	
glabrum, Gaud.	57	20	nil	
gracile, R. Br.	57	100	nil	
Isachne, Roth., var. eruciforme	15	20	nil	A. de C.
marginatum, R. Br.	54	60	nil	
melananthum, F. v. M.	54	100	nil	
miliaceum, Linn., var. album.	15	20	nil	A. de C.
miliacum, Linn., var. nigrum.	15	20	nil	A. de C.
persicum, Jensceh	12		nil	Nobbe.
prolutum, F. v. M.	57	150	nil	
sanguinale, L.	15	20	nil	A. de C.
semialatum, R. Br.	54	140*	nil	
virgatum, Linn.	1	30.5	36.5	Duvel. Buried deeply, 16 per cent.
Papaveraceæ.	25		nil	Becquerel.
Papaver.	many		some	Poisson.
Argemone, Linn.	15	20	nil	A. de C.
ditto	50	130	nil	
ditto	59	150	nil	
ditto	66	300	nil	

	Years old.	No. of Seeds.	*Per cent. Germ.	
ditto	75	1000	nil	
ditto	79	300	nil	
bracteatum, Lindl.	41	500	nil	
ditto	50	200	nil	
dubium, Linn.	fresh	100	48	1 h. at 100 deg. C.; dry.
ditto	24	300	nil	
ditto	59	150	nil	
hybridum, Linn.	6	1000	nil	
ditto	15	20	nil	A. de C.
ditto	16	100	nil	
ditto	55	1000	nil	
ditto	66	500	nil	
nudicaule, Linn., var. coccineum.	17	1000	nil	
nudicaule, Linn., var. alpinum.	17	500	nil	
ditto, var. pyrenaicum, Willd.	41	100	nil	
orientale, L.	15	20	nil	A. de C.
ditto	41	500	nil	
ditto	50	210	nil	
persicum, Lindl.	30	81	nil	
Rhoeas, L.	fresh	100	62	1 h. at 100 deg. C.; dry.
ditto	15	20	nil	A. de C.
ditto	18	110	nil	
ditto	20?		few	Peter. Supp. time in soil.
Rhoeas, L., var. syriacum, Boiss.	54	88	nil	
somniferum, L.			many	D. After 28 days in sea water.
ditto			nil	D. After 54 days in sea water.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	12	500	nil	
ditto	41	1000	nil	
ditto	50	200	nil	
ditto	50	450	nil	
ditto, var. setigerum, D. C.	59	500	nil	
Papaver, sp.	30		nil	Becquerel
Pappophorum commune, F. v. M.	47	50	nil	
ditto	57	200	nil	
ditto, var. urens, Lind.	54	55	nil	
Parthenium Hysterophorus, L.	15	20	nil	A. de C.
Paspalum scrobiculatum, L.	15	20	nil	A. de C.
ditto, L., var. orbiculare, Forst.	57	114	nil	
setaceum, Michx.	67	100	nil	
Patersonia longiscapa, Sweet.	50	40	nil	
Pavonia hastata, Cav.	50	17	nil	
ditto, var. Cleisocalyx, F. v. M.	57	20	nil	5 sw. H_2O.; rest after 1 hr. in acid.
Pedicularis sylvatica, L.	58	250	nil	
Pentstemon campanulatus, Willd.	50	150	nil	
confertus, Dougl., var. procerus.	50	80	nil	
Hartwegii, Benth., var. gentianoides, Lindl.	50	100	nil	
Peplis Portula, L.	55	1000	nil	
ditto	58	120	nil	
Persoonia ferruginea, Sm.	54	18	nil	
juniperina, Labill.	57	13	nil	
lanceolata, Andr.	57	14	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Petalostigma quadriloculare, F. v. M.	12	15	12.6	
ditto	23	41	nil	
Petrophila fastigiata, R. Br.	57	30	nil	
Peucedanum graveolens, Bth. and Hook.	3	100	50	Vilmorin. Ext. limit, 5 yrs.
palustre, Moench.	55	72	nil	
sativum, Bth and Hk. (Parnsip).	2	100*	50	Vilmorin. Ext. limit, 4 yrs.
ditto	1	55.5*	67	Duv. Buried deenly, 63 per cent.
ditto	57	100	nil	
ditto (Hollow crown Parnsip).	10	100	nil	
Phacelia arizonica, Gray.	23	110	nil	
congesta, Hook.	22	58	nil	
ditto	50	58	nil	
Whitlavia, A. Gray.	50	110	nil	
Phalaris arundinacea, Linn.	1	69*	8	Duvel. Buried deeply, 56 per cent.
ditto	57	100	nil	
canariensis, L.			most	D. After 70 days in sea water.
ditto			few	D. After 120 days in sea water.
ditto	15	20	nil	A. de C.
paradoxa, L.	15	20	nil	A. de C.
Phaseolus aconitifolius, L.	25	250	nil	
acutifolius, A. Gray.	21	16	nil	
coccineus, Moc. and Sesse. (Scarlet runner).	fresh	100	nil	Moist after 1 day at -10 deg. C.
lunatus, L.	10	12	nil	
lunatus, L. (Black pole).	10	25	nil	
lunatus, L. (Horticultural).	10	5	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
lunatus, L. (Burpees Dwarf).	10	8	nil	
lunatus, L. (Large white).	10	7	nil	
multiflorus, Willd.	12		nil	Nobbe.
Mungo, L., var. avies.	12	200	72	Began to germ. in 1 day after soaking in water at 22 deg. C.
Mungo, L., var. Max.	12	70	98	Began to germ. in 1 day at 22 deg. C.
ditto	12	300	94	Began to germ. in 1 day at 22 deg. C.
Mungo, L., var. radicatus.	13	34	3	2 days at 30 deg. C., after 5 days soak.
ditto	45	16	nil	
Mungo, L., var. Roxburghii.	12	150	91	At 30 deg. C. in 2 days.
Mungo, L., var. viridissimus, Ten.	13	200	61	At 30 deg. C. in 1 day.
ditto	20	77	44	All sw. in water.
pilosus, H. B. and K.	10	100	98	Sw and began to germ. in 2 days.
ditto	12	200	94	
ditto	18	100	12	Sw. in water.
sativus (pitted) } = Medicago sativa.	12		75	Nobbe.
sativus (Black) } = Medicago sativa.	12		nil	Nobbe.
violaceus, Moench.	15	20	nil	A. de C.
vulgaris, L. (Haricot).	fresh	100	84	Air dried; 15 per cent. H_2O.
ditto	fresh	100	60?	7 d. des. at 37 deg. C.; 4.68 per cent. H_2O.
ditto	fresh	100	2	45 d. des. at 37 deg. C.; 1.1 per cent. H_2O.
ditto	fresh	100	12	After 7 days in ster. oxygenless water.
ditto	fresh	100	nil	14 days in ster. oxygenless water.
ditto	fresh	100	39	Des. 7 days at 37 deg. C.
ditto	fresh	100	15	Des. 10 days at 37 deg. C.
ditto	fresh	100	3	Des. 14 days at 37 deg. C.

	Years old.	No. of Seeds.	Per cent. Germ.	
vulgaris, L.	fresh	100	95	5 days in oxygenless water.
ditto	fresh	100	nil	10 days in oxygenless water.
ditto	fresh	100	nil	After 1 day aqueous $HgCl_2$.
ditto	fresh	100	nil	After 21 days des. at 37 deg. C.
? (Beans).	2	10	20	Rom. Dried in air.
ditto	2	10	20	Rom. 1 yr, in O H N, CO or vacuo.
ditto	2	10	20	Rom.. 1 yr. in water, ether or chloroform vapour.
ditto	2	10	nil	Rom. 1 yr. H_2S.
P. vulgaris, L.			nil	D. After 10 days in sea water.
ditto	1	97.5*	98-5	Duvel. All died in soil.
ditto (Kidney or French bean).	3	100*	50	Vilmorin. Ext. limit, 8 yrs.
vulgaris, L.	12		nil	Nobbe.
ditto	100		some	Girardin (Herb. Tournefort).
Phebalium Billardierii, A. de Juss.	57	46	nil	
Philadelphus coronarius, L.	50	400	nil	
coronarius, Linn., var. verrucosus	50	150	nil	
ditto, var. Zeyheri.	50	300	nil	
Gordonianus, Lindl.	50	350	nil	
grandiflorus, Willd., var. floribundus.	50	180	nil	
grandiflorus, Willd., var. speciosus.	50	200	nil	
Philotheca australis, Rudge.	57	30	nil	
Phleum asperum, Jacq.	61	80	nil	
pratense, L.	fresh		83	Nobbe.
ditto	3		53	Nobbe.
ditto	5		46	Nobbe.

	Years old.	No. of Seeds.	Per cent. Germ.	
tenue. Schrad.	15	20	nil	A. de C.
tuberosa, Linn.	50	13	nil	
Phlox Drummondii, Hook.			3	D. After 15 days in sea water.
			nil	D. After 25 days in sea water.
Pholidia divaricata, F. v. M.	57	50	nil	
Phormium tenax, Forst.	18	200	nil	
ditto	12	100	nil	
ditto	6	50	nil	
ditto	50	52	nil	
Phylacium bracteosum, Bennet.	17	40	nil	Sw. in water.
		3	33	Sw. after ½ hr. in acid.
Phylica plumosa, Linn.	50	32	nil	
Phyllanthus australis, Hook.	57	10	nil	
hirtellus, Muell. Arg.	57	100	nil	
lacunarius, F. v. M.	67	135	nil	
Niruri, Linn.	15	20	nil	A. de C.
trachyspermus, F. v. M.	57	35	nil	
Physalis Alkekengi, L.	35	100	nil	
peruviana, L. (Cape Gooseberry).	77	100	nil	
ditto	8	100*	50	Vilmorin. Ext. limit, 10 yrs
ditto	50	160	nil	
Phyteuma campanuloides, Bieb.	50	82	nil	
Phytolacca, sp.			some	Thuret. After 13 m. fl. on sea water.
decandra, L.	15	20	nil	A. de C.
ditto, var. americana.	1	40.5*	88.5	Duvel. Buried deeply, 80 per cent.
dioica, L.	8	80	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
octandra, L.	57	64	nil	
ditto	61	100	nil	All sw. after 1 hr. in acid.
Picridium vulgare, Desf. (Cultivated sow-thistle).	5	100*	50	Vilmorin.
Picris hieracioides, L.	15	20	nil	A. de C.
ditto	15	200	nil	
ditto	55	130	nil	
hieracioides, L., var. squarrora.	64	200	nil	
Pimelea microcephala, R. Br.	47	50	nil	
pauciflora, R. Br.	51	100	nil	
Pimpinella Anisum, L. (Anise).	3	100*	50	Vilmorin. Ext. limit, 5 yrs.
integerrima, Benth. and Hook. f.	67	41	nil	
Pinus halepensis, Mill.	50	18	nil	
inops, Ait., var. virginiana.	1	18*	6.5	Duvel. All died in soil.
pinaster, Ait.	50	18	nil	
sylvestris, L.	2		60	Nobbe.
ditto	5		30	Nobbe.
Pisum sativum, Linn. (Peas).	fresh	100	80	5 days in abs. alc.
ditto	fresh	100	28	21 days in abs. alc.
ditto	fresh	100	16	49 days in abs. alc.
ditto	fresh	100	nil	63 days in abs. alc.
ditto	fresh	100	16	5 days $HgCl_2$ in abs. alc.
ditto	fresh	100	6	21 days $HgCl_2$ in abs. alc.
ditto	fresh	100	nil	42 days $HgCl_2$ in abs. alc.
ditto	fresh	100	40	49 days in 85-90 per cent. alc.
ditto	fresh	100	18	77 days in 85-90 per cent. alc.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	fresh	100	44	35 days in dry H and N.
ditto	fresh	100	15	Des. 21 days at 37 deg. C.
ditto	fresh	100	nil	Des. 42 days at 37 deg. C.
ditto	fresh		few	D. After 11 days in sea water.
ditto	fresh		nil	D. After 14 days in sea water.
ditto	fresh		nil	D. After 13 days in pure water.
ditto	fresh	100	44	10 days in abs. alc.
ditto	fresh	100	40	14 days in abs. alc.
ditto	fresh	100	46	5 days in 50 per cent. alc.
ditto	fresh	100	30	14 days in 50 per cent. alc.
ditto	fresh	100	nil	10 days in watery $HgCl_2$.
ditto	fresh	100	60	5 days in oxygenless water.
ditto	fresh	100	nil	14 days in oxygenless water.
ditto	2	10	60	Rom. Dried in air.
ditto	2	10	10	Rom. 15 months in vacuo.
ditto.	2	10	80	Rom. 1 yr. in O or N.
ditto	2	10	90	Rom. 1 yr. in H or water or ether vapour.
ditto	2	10	60	Rom. 1 yr. in CO or H_2S.
ditto	2	10		Rom. 1 yr. in chloroform vapour.
ditto	3	100	73	Air dried.
ditto	3	100	20	Air dried after 14 days in abs. alc.
ditto	fresh	100	70	After 7 d. in ster. oxygenless H_2O.
ditto	fresh	100	3	After 21 d. in ster. oxygenless H_2O.
ditto	fresh	100	nil	After 28 d. in ster. oxygenless H_2O.
ditto	fresh	100	70	After 2 soakings and dryings.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	fresh	100	12	After 3 soakings and dryings.
ditto	fresh	100	5	2 d. aqueous $HgCl_2$, then 1 d. washing.
ditto	fresh		nil	D. After 5 days in sea water.
ditto	1	99*	98	Duvel. Buried; all died.
ditto	fresh		100	Nobbe.
ditto	3		88	Nobbe.
ditto	3	100*	50	Vilmorin. Ext. limit, 8 yrs.
ditto	4½	10	80	Jodin. Kept under mercury.
ditto	10¼	10	40	Jodin. Kept under mercury.
ditto (Poisgris).	8	100*	nil	Vilmorin. Dry in air.
ditto	10		33	Nobbe.
ditto	12		30	Nobbe.
sativum, L., var, arvense.	3	100*	50	Vilmorin. Ext. limit, 8 yrs.
Pithecolobium pruinosum, Bth.	16	4	nil	Sw. in water after 2 hr. in acid.
		37	21.6	
Pittosporum bicolor, Hook.	50	21	nil	
eugenioides, A. Cunn.	47	32	nil	
undulatum, Vent.	57	52	nil	
ditto	57	100	nil	
Plagianthus pulchellus, A. Gray.	57	100	nil	
spicatus, Benth.	54	200	nil	
Plantaginaceæ.	25		nil	
Plantago albicans, L.	63	88	nil	
arenaria, Waldst. and Kit.	41	100	nil	
ditto	70	50	nil	
ditto	73	200	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
argentea, Chaix., var. sericea.	77	25	nil	
Brownii, Rafin., var. carnosa.	57	33	nil	
ciliata, Desf.	40	500	nil	
Coronopus, L.	4	100*	50*	Vilmorin. Ext. limit, 9 yrs.
ditto	32	150	nil	
ditto	55	500	nil	
ditto	57	52	nil	
ditto	73	250	nil	
ditto	75	250	nil	
Cynops, L.	7	38	nil	
ditto	15	20	nil	A. de C.
ditto	87	80	nil	
Hugelii, Decne.	1	4*	5.5	Duvel. Buried deeply, 13.5 per cent.
Lagopus, var. vaginata, L.	15	20	nil	A. de C.
lanceolata, L.	1	82.5*	78	Duvel. Buried deeply, 41 per cent.
ditto	15	20	nil	A. de C.
major, L., var. asiatica.	6	120	nil	
ditto	6	210	nil	
major, L.	1	24*	78	Duvel. Buried deeply, 46 per cent.
ditto	16	145	nil	
ditto	18?		few	Peter. Supp. age in soil.
ditto	20?		few	Peter. Supp. time in soil.
ditto	22	500	nil	
ditto	32?		few	Peter. supp. age in ground.
ditto	32	250	nil	
ditto	36	300	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	37	88	nil	
ditto	45?		some	Peter. Supp. time buried.
ditto	57	60	nil	
ditto	100?		few	Peter. Supp. age in ground.
ditto	300		nil	Nobbe. (Old Herb.).
maritima, L.	55	96	nil	
ditto	64	100	nil	
ditto	83	149	nil	
maxima, Jacq.	15	20	nil	A. de C.
media, Linn.	15	20	nil	A. de C.
varia, R. Br.	54	100	nil	
ditto, var. leiostachys, F. v. M.	59	100	nil	
Platylobium obtusangulum, Hook., var. macrocalyx.	51	30	nil	
Plectranthus fruticosus, L. Herit.	15	20	nil	A. de C.
parviflorus, Willd.	57	48	nil	
ditto	15	20	nil	A. de C.
Plumbaginaceæ.	25		nil	Becquerel.
Poa annua, L.	12	500	nil	
ditto	18?		few	Peter. Supp. age in soil.
ditto	22?		few	Peter. Supp. age in soil.
ditto	25	250	nil	
caespitosa, Forst. f., var. australis.	35	53	nil	
ditto	37	164	nil	
ditto	57	100	nil	
ditto	57	160	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
compressa, L.	14	450	nil	
ditto	20?		few	Peter. Supp. age in soil.
nemoralis, L.	12	250	nil	
ditto	14	400	nil	
ditto	36?		few	Peter. Supp. age in soil.
ditto	50	180	nil	
ditto	100?		few	Peter. Supp. age in soil.
ditto, var. brizochloa, F. v. M.	57	47	nil	
pratensis, L.	fresh		95	Kinzel. In light at 20 deg. C.
ditto			nil	Kinzel. Darkness at 20 deg. C.
ditto	1	91*	87	Duvel. Buried deeply, 24.5 per cent.
Podalyria calyptrata, Willd., var. styracifolia, Sims.	50	26	nil	
ditto	51	26	3.8	
sericea, R. Br.	51	97	1	
Podocarpus alpina, R. Br.	57	50	nil	
elata, R. Br.	8	12	nil	
ditto	57	20	nil	
Podolepis canescens, A. Cunn., var. affinis, Sond.	57	180	nil	
longipedata, A. Cunn., var. hieracioides, F. v. M.	54	800	nil	
ditto, var. Mitchellii, Sond.	57	450	nil	
rugata, Labill.	50	35	nil	
Poinciana regia, Boj.	9	19	47.4	Outer thin skin impermeable until filed.
Polycarpaea Teneriffae, Lam.	15	20	nil	A. de C.

	Years old.	No. of Seeds.	Per cent. Germ.	
Polygala myrtifolia, Linn.	50	47	nil	
polygama, Walt.	67	52	nil	
Senega, Linn.	67	100	nil	
Polygonaceæ.	25		nil	Becquerel.
Polygonum amphibium, L.	ripe		nil	Coats intact. Crocker.
ditto	ripe		85	Coats broken. Crocker.
aviculare, L.	18	150	nil	
ditto	20?		few	Peter. Supp. time buried.
ditto	22?		few	Peter. Supp. time buried.
ditto	53	51	nil	
Convolvulus, L.	20?		few	Peter. Supp. time buried.
ditto	22	125	nil	
ditto	32	55	nil	Sand-p.
ditto	36?		few	Peter. Supp. age in soil.
dumetorum, L.	50	58	nil	
dumetorum, L., var. scandens.	1		nil	Duvel. If buried, died.
hydropiperoides, Michx.	67	80	nil	
lapathifolium, Linn., var. glandulosum.	54	50	nil	
ditto	57	500	nil	
maritimum, L.	55	48	nil	
minus, Huds.	57	65	nil	
orientale, L.	15	20	nil	A. de C.
pensylvanicum, L.	1		nil	Duvel. If buried, died.
ditto	67	104	nil	
Persicaria, L.	1		nil	Duvel. If buried, died.
ditto	49	51	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Roberti, Loisel.	57	42	nil	
Roberti, Loisel, var. Raii, Bab.	61	32	nil	
subsessile, R. Br.	54	25	nil	
virginianum, Linn.	67	60	nil	
viviparum, L.	50	38	nil	
Pomaderris elliptica, Labill.	50	120	nil	
ditto	57	100	nil	
elliptica, Labill. (malifolia).	50	36	nil	
ligustrina, Sieb.	57	100	nil	
obcordata, Fenzl.	54	100	nil	
phylicaefolia, Lodd.	57	100	nil	
phylliraeoides, Sieber.	50	32	nil	
racemosa, Hook.	57	150	nil	
subrepanda, F. v. M.	50	120	nil	
Portulaca grandiflora, Hook.	50	110	nil	
oleracea, Linn. (Purslane).	1	84*	91.5	Duvel. Buried deeply, 39 per cent.
ditto	7	100*	50	Vilmorin. Ext. limit, 10 yrs.
ditto	50	2670	nil	
ditto	57	150	nil	
pilosa, Linn.	15	20	nil	A. de C.
Potamogeton coloratus, Hornem., var. plantagineus.	50	100	nil	
filiformis, Rafin.	56	28	nil	
marinus, L.	54	32	nil	
natans, L.	55	130	nil	
ditto	ripe		nil	Coats intact. Crocker.
ditto	ripe		51	Coats broken. Crocker.

	Years old.	No. of Seeds.	Per cent. Germ.	
obtusifolius, M. and K.	57	18	nil	
pectinatus, L.	ripe		nil	Coats intact. Crocker.
ditto	ripe		53	Coats broken. Crocker.
pusillus, L.	55	90	nil	
ditto	58	30	nil	
zosterifolius, Schum.	55	40	nil	
Potentilla alpestris, L.	50	51	nil	
aurea, Linn., var. argentea.	55	200	nil	
inclinata, Vill.	50	106	nil	
Macnabiana, Lem.	50	112	nil	
micrantha, Ram.	50	32	nil	
norvegica, L.	67	250	nil	
ditto, var. monspeliensis, L.	1	41*	83	Duvel. Buried deeply, 21.5 per cent.
pensylvanica, L., var. bipinnatifolia, Doug.	50	170	nil	
ditto	50	250	nil	
recta, L.	50	160	nil	
rupestris, L.	50	120	nil	
Sibbaldi, Hall, f.	56	62	nil	
Tormentilla, Neck.	17	180	nil	
ditto	20?		few	Peter. Supp. time in soil.
ditto	30	75	nil	
ditto	30*		nil	Becquerel.
ditto	32?		few	Peter. Supp. age in ground.
ditto	52	68	nil	
ditto	100?		many	Peter. Supp. age in soil.

	Years old.	No. of Seeds.	Per cen. Germ.	
verna, Linn., var. pilosa, Kitt.	50	88	nil	
Poterium canadense, A. Gray.	15	20	nil	A. de C.
Sanguisorba, L. (Garden-burnet).	2	100*	50	Vilmorin. Ext. limit, 6 yrs.
Sanguisorba, L.	50	140	nil	
Priestleya villosa, D. C. (formulosa).	50	31	nil	
Primula mollis, Nutt.	50	160	nil	
Priva hispida, Juss., var. mexicana, Pers.	15	20	nil	A. de C.
Prostanthera lasianthos, Labill.	50	70	nil	
ditto	55	52	nil	
melissifolia, F. v. M.	57	28	nil	
microphylla, A. Cunn., var. coccinea, F. v. M.	57	40	nil	
nivea, A. Cunn.	50	150	nil	
ditto	57	100	nil	
rotundifolia, R. Br. (retusa).	57	100	nil	6 weeks moist, then ½ hr. in acid.
ditto	57	100	nil	In acid ½ hr.
spinosa, F. v. M.	57	72	nil	
Protea mellifera, Thunb.	50	14	nil	
Prunella vulgaris, L.	22	58	nil	
ditto	36?		few	Peter. Supp. time in soil.
ditto	45?		few	Peter. Supp. time buried.
ditto	50	44	nil	
Prunus serotina, Ehrh.	27	18	nil	
ditto	67	15	nil	
Pseudanthus ovalifolius, F. v. M., var. brachyandrus.	57	120	1.7	Partial germination only.

	Years old.	No. of Seeds.	Per cent. Germ.	
Psidium Donianum, Berg. (aromaticum).	15	20	nil	A. de C.
Psoralea adscendens, F. v. M.	57	35	nil	Imp. ripe.
aphylla, Linn.	50	50	nil	
argophylla, Pursh. (incana).	50	28	nil	
bituminosa, Linn.	50	71	nil	
glandulosa, Linn.	50	16	nil	
patens, Lindl., var. australasica.	50	52	nil	
ditto	57	50	nil	Imp. ripe.
pinnata, Linn.	51	48	10.4	Most germ. without filing after prolonged soaking.
striata, Thunb.	50	41	nil	
Psychotria loniceroides, Sieber.	10	85	nil	
Pterostylis pedunculata, R. Br.	55	500	nil	
Pultenaea baeckeoides, A. Cunn.	57	80	2.5	In acid 1 hr.
daphnoides, Wendl.	12	20	35	Sw. after 2½ hr. in acid.
ditto	19	100	7	
ditto	50	21	nil	
retusa, Sm.	10	100	62	In acid 1½ hr.
ditto	22	50	4	In acid 1½ hr.
ditto	57	50	nil	
stipularis, Sm.	12	50	48	1 hr. in acid.
ditto	16	25	8	1 hr. in acid.
subumbellata, Hook.	57	18	nil	
villosa, Willd.	16	5	nil	Sw. in water.
		48	25	In acid 2 hr.
Pyrus arbutifolia, Linn. f.	50	14	nil	

	Years old.	No. of Seeds.	Per cent Germ	
ditto, var. depressa, Lindl.	50	15	nil	
ditto, var. floribunda, Lindl.	50	19	nil	
ditto, var. pubens, Lindl.	50	18	nil	
Aria, Ehrh., var. undulata.	50	26	nil	
Aucuparia, Ehrh. (saturigifolia).	50	30	nil	
coronaria, Linn.	23		some	Arthur. Supp. age in soil.
prunifolia, Willd. (hybrida).	50	15	nil	
Spuria, D. C.	50	80	nil	
Quercus Robur, Linn.	1		nil	Wiesner.
ditto	1	100	nil	
ditto	fresh	100	86	
ditto, var. sessiliflora, Salisb.	1	100	nil	
ditto	fresh	100	74	
Quisqualis indica, L.	8	2	nil	
Radiola Linoides, Roth. (Millegrana).	51	80	nil	
Ranunculaceæ.	25		nil	Becquerel.
Ranunculus anemoneus, F. v. M.	57	82	nil	
aquatilis, L.	56	32	nil	
arvensis, L.	56	51	nil	
bulbosus, L.	15	20	nil	A. de C.
Ficaria, L.	1	100	nil	Kept in desiccator at 10-20 deg. C.
ditto	3	150	nil	Air dried.
ditto	2	100	nil	
lappaceus, Sm., var. multiscapus, Hook. f.	57	100	nil	
ditto, var. pimpinellifolius, Hook.	57	41	nil	

	Years old.	No. of Seeds.	Per cent. Germ.		
lappaceus, Sm., var. scapigerus, Hook.	57	48	nil		
multiscapus, J. Hook.	57	40	nil		
muricatus, L.	15	20	nil	A. de C.	
ditto	50	64	nil		
ditto	57	57	nil		
parviflorus, L.	15	20	nil	A. de C.	
ditto	50	110	nil		
ditto	58	92	nil		
ditto, var. sessiliflorus.	57	63	nil		
plebeius, R. Br., var. hirtus, B. and Sol.	54	71	nil		
ditto	27	38	nil		
ditto	37	40	nil		
recurvatus, Poir.	60	88	nil		
repens, L.	14	85	nil		
ditto	18	106	nil		
ditto	20?		many	Peter.	Supp. time in soil.
ditto	28	44	nil		
ditto	36?		some	Peter.	Supp. time in soil.
ditto	45?		many	Peter.	Supp. time buried.
ditto	50	80	nil		
ditto	100?		few	Peter.	Supp. age in soil.
ditto	71	56	nil		
ditto	64	52	nil		
repens, L., var. philonitis, Pursh.	50	25	nil		

	Years old.	No. of Seeds.	Per cent Germ		
rivularis, B. and S.	57	44	nil		
ditto, var. glabrifolius, Hook.	57	61	nil		
soeleratus, L.	50	63	nil		
ditto	25	65	nil		
trichocarpus, Boiss. and Kotschy.	50	17	nil		
trichophyllus, Chaix.	55	39	nil		
ditto, var. paucistamineus, Tausch.	55	76	nil		
trilobus, Desf.	50	34	nil		
velutinus, Tenore.	50	17	nil		
Raphanus Raphanistrum, L.	2	10	40	Rom.	Air dried.
ditto	2	10	80	Rom.	15 hr. in vacuo.
ditto	2	10	10	Rom.	1 yr. in OH or CO.
ditto	2	10	90	Rom.	1 yr. in N.
ditto	2	10	nil	Rom.	1 yr. in H_2S.
ditto	2	10	60	Rom.	1 yr. in water vapour.
ditto	2	10	40	Rom.	1 yr. in ether vapour.
ditto	2	10	80	Rom.	1 yr. in chloroform vapour.
ditto	18?		few	Peter.	Supp. age in soil.
ditto	36?		few	Peter.	Supp. age in soil.
ditto	50	110	nil		
sativus, L. (Radish).		30	6	D.	After 85 days in sea water.
ditto			nil	D.	After 50 days in cold sea water.
ditto	5	100*	50	Vilmorin.	Ext. limit, 10 yrs.
ditto	7	200	74		
Ratonia pyriformis, Benth. and Hook. f.	57	100	nil		
Reseda alba, Linn., var. fruticulosa, L.	50	80	nil		

	Years old.	No. of Seeds.	Per cent Germ.	
lutea, L.	55	200	nil	
ditto	57	100	nil	
odorata, L.	15	20	nil	A. de C.
Rhagadiolus edulis, Gaertn., var. stellatus.	50	12	nil	
Rhagodia Billardieri, R. Br.	54	100	nil	Sand-papered.
Rhamnus Frangula, L.	55	40	nil	
Rheum officinale, Baill. (Rhubarb).	3	100*	50	Vilmorin. Ext. limit, 8 yrs.
Rhaponticum, Linn.			many	D. After 82 days in sea water.
Rhizophora mucronta, Lam.			some	Hemsley. Many m. fl. on sea water.
ditto	1	50	nil	Dried in air.
Rhodosphaera rhodanthema, Engl.	15	22	nil	
Rhus lucida, Linn.	15	20	nil	A. de C.
venenata, D. C.	67	51	nil	
Rhynchosia minima, D. C.	14	11	nil	Sw, in water.
		9	33	Sw. after 1 hr. in acid.
ditto	18	25	8	Sw. after 1 hr. in acid.
nummularia, D. C.	36		some	Becquerel.
volubilis, Lour.	37	5	nil	Sw. in water.
		10	nil	Sw. after 1 hr. in acid.
Rhynchospora glomerata, Vahl.	67	160	nil	
Ribes sanguineum, Pursh.	50	10	nil	
ditto, var. atrosanguineum.	50	30	nil	
ditto, var. glutinosum.	50	34	nil	
Ricinocarpus pinifolius, Desf., var. sidaeformis.	50	16	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Ricinus communis, L., var. africanus.			some	Mart. After 93 d. fl on sea water.
communis, Linn.	fresh	100	40	Des. 28 days to 0.92 per cent. H_2O.
ditto			some	D. After 30 days in sea water.
ditto			some	Mart. After 93 d. fl. on sea water.
ditto	50	10	nil	
Rivina humilis, Linn., var. brasiliensis.	15	20	nil	A. de C.
Robinia pseudacacia, L.	1	14	11.5	Duvel. Buried in soil; all died.
Romulea neglecta, Jord. and Fourr.	15	20	nil	A. de C.
ramiflora, Tenore.	15	20	nil	A. de C.
rosea, Eckl.			some	Berkeley. After 1 month in sea water.
Rosa gallica, Linn., var. virescens, Desegl.	50	11	nil	
lucida, Ehrb.	60	82	nil	
montana, Chaix.	50	24	nil	
procera, Hort.	50	32	nil	
rubiginosa, Linn., var. latifolia.	50	16	nil	
spinosissima, L.	56	60	nil	
turbinata, Ait.	50	15	nil	
Rosaceæ.	25		nil	Becquerel.
Rosmarinus officinalis, L. (Rosemary).	2	100*	50	Vilmorin.
Rubia tinctorum, Linn.	50	34	nil	
Rubus chamaemorus, L.	56	31	nil	
Idaeus, L.	18	98	nil	
ditto	30	68	nil	
ditto	30		nil	Becquerel.
ditto	35?		few	Peter. Supp. age in soil.
ditto	36?		few	Peter. Supp. time in soil.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	45?		few	Peter. Supp. time buried.
ditto	50	120	nil	
ditto	100?		few	Peter. Supp. age in soil.
ditto	-2000		some	Lindley. Supp. age in soil.
parvifolius, Linn., var. macropodus, Seringl.	57	20	nil	
parvifolius, L.	37	25	nil	
ditto	37	50	nil	
rosaefolius, Sm.	57	100	nil	
rosaefolius, Sm., var. Eglanteria.	57	100	nil	
Rudbeckia amplexicaulis, Vahl.	50	45	nil	
hirta, L.	1	65	78	Duvel. Buried in soil, 7 per cent.
ditto	50	45	nil	
laciniata, L.	50	36	nil	
Rulingia parviflora, Endl.	50	41	nil	
Rumex, Acetosa, L. (Sorrel).	2	100*	50	Vilmorin. Ext. limit, 4 yrs.
Acetosella, L.	15	150	nil	
ditto	18?		some	Peter. Supp. age in soil.
ditto	25	130	nil	
acutus, Linn., var. pratensis.	55	120	nil	
alpinus, L.	69	108	nil	
angustifolius, Campd.	57	150	nil	
aquaticus, L.			some	Mart. After 93 d. fl. on sea water.
ditto	50	120	nil	
crispus, L.	1	81*	83.5	Duvel. Buried deeply, 79 per cent.
ditto	59	150	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Hydrolapathum, Huds.	15	20	nil	A. de C.
ditto	55	100	nil	
littoralis, H. B. and K.	15	20	nil	A. de C.
Lunaria, Linn.	15	20	nil	A. de C.
maritimus, Linn.	55	250	nil	
nemorosus, Schrad.	22	45	nil	
ditto	35?		few	Peter. Supp. age in soil.
obtusifolius, Linn.	1	97.5*	95.5	Duvel. Buried deeply, 79 per cent.
palustris, Sm.	56	100	nil	
Patientia, L. (Patience dock).	4	100*	50	Vilmorin. Ext. limit, 6 yrs.
Pulcher, L.	55	100	nil	
salicifolius, Wienm.	1	98*	96	Duvel. Buried deeply, 70 per cent.
verticillatus, L.	67	38	nil	
Ruta graveolens, L. (Rue).	4	100*	50	Vilmorin. Ext. limit, 6 yrs.
Rutidosis Pumilo, Benth.	57	500	nil	
Sagina maritima, Don.	30	250	nil	
ditto	56	1000	nil	
nodosa, Fenzl.	41	740	nil	
ditto	54	550	nil	
procumbens, Linn.	16	250	nil	
ditto	30		nil	Becquerel.
ditto	18?		many	Peter. Supp. age in soil.
ditto	25	120	nil	
ditto	35?		few	Peter. Supp. age in soil.
ditto	36?		few	Peter. Supp. time in soil.
ditto	41	2000	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	45?		few	Peter. Supp. time buried.
ditto	50	500	nil	
ditto	100?		few	Peter. Supp. age in soil.
ditto	30*		nil	Becquerel.
Sagittaria sagittifolia, L.	10		many	Fischer. After treatment with dil. acid.
ditto	10		many	Fischer. After treatment with dil. acid.
ditto	1	varied	50-90	Fischer. After treatment with dil. acid.
ditto	1	100	68	After light sandpapering and moisture at 25-30 deg. C. None living after 3 weeks.
ditto	1	1400	0.1	Fischer. During 1 yr. in clear water.
ditto	10	1320	2.8	Fischer. During 1 yr. in clear water.
ditto	1	7000	5.7	Fischer. Water slightly soured.
platyphylla, J. G. Smith.	1	4300	0.7	Fischer. During 1 yr. in water.
variabilis, Engelm.	ripe		nil	Coats intact. Crocker.
ditto	ripe		92	Coats broken. Crocker.
Sagus, sp.	fresh		some	Moseley. After months in sea water.
Salicornia Bigelowii, Torr., var.	67	100	nil	
Salix.	fresh		nil	After thorough drying.
Salsola Kali, L.	fresh		some	Mart. After 45 d. fl. on sea water.
ditto	67	21	nil	
Salvia Aethiopis, L.	15	20	nil	A. de C.
ditto	50	53	nil	
algeriensis, Desf.	50	25	nil	
argentea, L., var. orientalis	50	15	nil	
foetida, Lam., var. tingitana.	15	20	nil	A. de C.

	Years old.	No. of Seeds.	Per cent. Germ.	
glutinosa, L.	50	16	nil	
hirsuta, Jacq.	15	20	nil	A. de C.
hispanica, Linn.	15	20	nil	A. de C.
indica, Linn.	15	20	nil	A. de C.
lanceolata, Brouss.	15	20	nil	A. de C.
officinalis, L. (Garden sage).	3	100*	50	Vilmorin. Ext. limit, 5 yrs.
plebeia, R. Br.	50	240	nil	
ditto	57	200	nil	Softened in water.
pratensis, Linn.	57	20	nil	
Sclarea, L. (Clary).	3	100*	50	Vilmorin.
ditto	15	20	nil	A. de C.
ditto	50	49	nil	
ditto	50	55	nil	
spinosa, L.	50	148	nil	
verbascifolia, Bieb.	50	35	nil	
Verbenaca, L.	55	110	nil	
verticillata, Linn.	15	20	nil	A. de C.
ditto	50	72	nil	
verticillata, Linn., var. napifolia.	15	20	nil	A. de C.
viridis, Linn.	50	32	nil	
viscosa, Jacq.	15	20	nil	A. de C.
Sambucus nigra, L.	18	82	nil	
ditto	50	32	nil	
racemosa, L.	12	140	nil	
ditto	100?		few	Peter. Supp. age in soil.
xanthocarpa, F. v. M.	57	40	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Samolus littoralis, Schrank.	57	45	nil	
repens, Pers., var. parviflorus.	57	150	nil	
Valerandi, L.	57	160	nil	
ditto, var. floribundus, H. B. and K.	57	250	nil	
Santalum lanceolatum, R. Br.	17	44	nil	
Santolina chamaecyparissus, L.	50	450	nil	
rosmarinifolia, Linn.	50	170	nil	
viridis, Willd.	50	190	nil	
Sapindus Saponaria, L.			some	Hemsley. After months in sea water.
Saponaria Vaccaria, L.	15	20	nil	A. de C.
ditto	1	6.5*	88	Duvel. Buried in soil, 7 per cent.
Satureia hortensis, L. (Summer savory).	fresh		3	D. After 42 days in sea water.
ditto	3	100*	50	Vilmorin. Ext. limit, 7 yrs.
ditto	15	20	nil	A. de C.
montana, L. (Winter savory).	3	100*	50	Vilmorin. Ext. limit, 6 yrs.
Saussurea japonica, D. C.	15	20	nil	A. de C.
Saxifraga, var.	50	500	nil	
aizoides, Linn.			nil	D. After 30 days in sea water.
ajujifolia, L.	50	25	nil	
caespitosa, L., var. incurvifolia, Don.			nil	D. After 30 days in sea water.
Geum, L.	50	75	nil	
marginata, Sternb.	50	100	nil	
umbrosa, L.	57	106	nil	
Saxifragaceæ.	25		nil	Becquerel.
Scabiosa arvensis, L.	66	120	nil	
ditto	18	48	nil	
ditto	50	11	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
graminifolia, Linn.	50	32	nil	
maritima, Linn.	50	86	nil	
ditto	fresh		some	Mart. After 45 d. fl. on sea water.
maritima, Linn., var. atropurpurea, Linn.	50	11	nil	
succisa, Linn.	15	20	nil	A. de C.
Scaevola Hookeri, F. v. M.	15	40	5	
suaveolens, R. Br.	54	32	nil	
Schinus dependens, Orteg.	15	20	nil	
molle, Linn.	8	40	nil	
Schotia latifolia, Jacq.	8	5	nil	After filing integ. outer transp. layer scales off on swelling.
Scirpus Eriophorum, Michx.	67	1000	nil	
lacustris, L.	51	100	nil	
maritimus, L.	57	150	nil	Sand-papered.
nodosus, Rottb.	57	30	nil	
setaceus, L.	60	120	nil	
Scleranthus annuus, L.	16	85	nil	
ditto	18?		few	Peter. Supp. age in soil.
ditto	50	200	nil	
biflorus, Hook. f.	56	100	nil	
ditto	57	100	nil	
mniaroides, F. v. M.	57	50	nil	
ditto	57	50	nil	
Scleria ciliata, Michx.	67	20	nil	
Sclerocarpus uniserialis, Bth. & Hook f.	50	21	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Sclerolaena biflora, R. Br.	57	14	nil	
dicantha, Bth.	57	150	nil	
paradoxa, R. Br.	57	36	nil	
ditto	57	45	nil	
Sclerothamnus diffusus, F. v. M. (Eutaxia)	50	29	nil	
Scolymus hispanicus, L. (Golden thistle).	3	100*	50	Vilmorin. Ext. limit, 7 yrs.
Scorpiurus muricata, Linn., var. vermiculata.	6	100*	50	Vilmorin. Ext. limit, 10 yrs.
vermiculata, L.	6	100*	50	Vilmorin. Ext. limit, 10 yrs.
Scorzonera hispanica, L. (Scorzonera).	2	100*	50	Vilmorin. Ext. limit, 7 yrs.
Scrophularia aquatica, Linn.	15	20	nil	A. de C.
nodosa, Linn.	50	100	nil	
ditto	12	500	nil	
ditto	100?		few	Peter. Supp. age in soil.
ditto	58	1000	nil	
vernalis, Linn.	58	1000	nil	
Scrophulariaceæ.	25		nil	Becquerel.
Scutellaria alpina, L.	50	22	nil	
Sebaea albidiflora, F. v. M.	54	100	nil	
ovata, R. Br.	37	250	nil	
ditto	55	100	nil	
Secale cereale, L. (Rye).	1	100*	98.5	Duvel. If buried, all died.
ditto	2		nil	Wiesner
ditto	2		most	Rohde.
ditto	fresh		100	Nobbe.
ditto	2		87	Nobbe.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	5		26	Nobbe.
ditto	2	100	48	Haberlandt.
ditto	3	100	nil	Haberlandt.
ditto	6	100	74	Haberlandt.
ditto	8	100	6	Haberlandt.
ditto	10	100	nil	Haberlandt.
ditto	4	100	78	Burgerstein. Dry in air.
ditto	4	25	32	From Vict. Agric. Dept.
ditto	7	100	35	
ditto	10	100	2	
ditto	50	120	nil	
ditto	100		some	Stated by Hemsley.
Securigera Coronilla, D. C.	50	14	nil	
Sedum Ewersii, Ledeb. (rubrum).	50	200	nil	
maximum, Suter. (latifolium).	50	60	nil	
Selinum sylvestre, Linn. (lineare).	15	20	nil	A. de C.
Sempervivum globiferum, L., var. soboliferum, Sims.	50	600	nil	
Senebiera Coronopus, Poir.	62	100	nil	
pinnatifida, D. C., var. didyma.	58	131	nil	
ditto	50	160	nil	
Senecio Fuchsii., C. C. Gmel.	100?		few	Peter. Supp. age in soil.
halimifolius, L.	50	300	nil	
lautus, Soland. (macquariensis).	55	100	nil	
sarracenicus, Linn.	59	1000	nil	
spathulatus, A. Rich.	57	100	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
sylvaticus, Linn.	indef.		some	Michalet. In soil.
ditto	12	500	nil	
ditto	19	250	nil	
ditto	54	200	nil	
ditto	55	52	nil	
ditto	69	64	nil	
ditto	81	128	nil	
viscosus, L.	57	80	nil	
vulgaris, L.	55	200	nil	
Serratula coronata, L.	50	17	nil	
Sesbania aculeata, Poir.	15	20	nil	A. de C.
ditto, var. australis, F. v. M.	57	100	nil	All sw. in water.
aegyptiaca, Poir.	61	58	nil	
punicea, Bth.	50	40	nil	
Setaria glauca, Beauv.	54	50	nil	
glauca, H. B. and K.	1	56*	37.5	Duvel. Buried.
ditto	1	56*	1	
italica, Beauv.	15	20	nil	A. de C.
ditto	22	400	nil	
ditto	18	200	nil	
ditto	52	800	nil	
macrochaeta, Spreng.	15	20	nil	A. de C.
macrostachya, H. B. and K.	15	20	nil	A. de C.
verticillata, Beauv.	15	20	nil	A. de C.
ditto	1	93*	94.5	Duvel. Buried deeply, 90 per cent.

	Years old.	No. of Seeds.	Per cent. Germ.	
viridis, Beauv.	57	2000	nil	
ditto	61	80	nil	
ditto	61	144	nil	
Sherardia arvensis, L.	61	42	nil	
Sida corrugata, Lindl.	55	30	nil	
ditto, var. humillima, F. v. M.	57	50	nil	
ditto, var. trichopoda, F. v. M.	57	20	nil	
glomerata, Cav., var. molle, Rich.	50	48	nil	
hastata, A. St. Hil.	15	20	nil	A. de C.
intricata, F. v. M.	57	30	3.3	14 sw. after ½ hr. in acid; rest in water.
Siegesbeckia orientalis, L., var. microcephala, D. C.	57	50	nil	
orientalis, L.	35	100	nil	
ditto	57	100	nil	
Silene antirrhina, L.	15	20	nil	A. de C.
apetala, Willd.	15	20	nil	A. de C.
atocioides, Boiss.			some	Thuret. After 13 m. fl. on sea water.
cerastoides, Linn.	15	20	nil	A. de C.
compacta, Fisch.			some	Berkeley. After 30 days in sea water.
conica, Linn.	15	20	nil	A. de C.
ditto	52	81	nil	
conoidea, Linn.	15	20	nil	A. de C.
fruticosa, L.	15	20	nil	A. de C.
gallica, L., var. anglica, L.	56	63	nil	
ditto	15	20	nil	A. de C.
gallica, L., var. quinquevulnera, L.	15	20	nil	A. de C.

	Years old.	No. of Seeds.	Per cent. Germ.	
juvenalis, Del.	1500		some	V. Heldreich. Supp. age in soil.
maritima, With.	55	59	nil	
noctiflora, L.	15	20	nil	A. de C.
ditto	55	71	nil	
ditto	57	120	nil	
nutans, L.	51	200	nil	
pendula, L.	50	92	nil	
perfoliata, L., var. erythrocaulon.	50	17	nil	
tartarica, Pers.	50	90	nil	
tricuspidata, Desf.	15	20	nil	A. de C.
trifoliatum, L.	15	20	nil	A. de C.
vespertina, Retz.	15	20	nil	A. de C.
Sinapis arvensis, L.	30		nil	Becquerel.
Sisymbrium altissimum, L.	1	88*	86	Duvel. Buried deeply, 26 per cent
austriacum, Jacq., var. acutangulum, D. C.	15	20	nil	A. de C.
canescens, Nutt.	50	104	nil	
cardaminoides, F. v. M.	29	100	nil	
ditto	59	200	nil	
Irio, L.	65	200	nil	
Loeselii, Linn., var. hirsutum.	15	20	nil	A. de C.
Sophia, L., var. persicum.	15	20	nil	A. de C.
strictissimum, L.	50	102	nil	
Thalianum, J. Gay.	18?		few	Peter. Supp. age in soil.
ditto	59	100	nil	
ditto	67	120	nil	

	Years old.	No. of Seeds.	Per cent. Germ.		
Sisyrinchium convolutum, Nocca.	50	180	nil		
iridifolium, H. B. and K.			some	Berkeley.	After 1 month in sea water.
striatum, Sm.	50	60	nil		
Sium Sisarum, L.	3	100*	50	Vilmorin.	Ext. limit, 4 yrs.
Smilax australis, R. Br., var. spinescens, Mig.	57	19	nil		
glyciphylla, Sm.	57	100	nil		
Solanaceæ.	25	100	nil	Becquerel.	
Solanum aculeatissimum, Jacq., var. ciliatum, Willd.	15	20	nil	A. de C.	
auriculatum, Ait.	50	210	nil		
aviculare, Forst. f., var. vescum, F. v. M.	57	42	nil		
discolor, R. Br., var. minus.	54	30	nil		
Dulcamara, Linn.	50	28	nil		
giganteum, Jacq.	50	130	nil		
Hystrix, R. Br.	50	85	nil		
Melongena, L.			some	Berkeley.	After 30 days in sea water.
Melongena, L. (Egg-plant).	6	100*	50	Vilmorin.	Ext. limit, 10 yrs.
ditto	50	40	nil		
nigrum, L.	1	97*	91	Duvel.	Buried in soil, 12 per cent.
nigrum, L. (Nightshade).	5	100*	50	Vilmorin.	Ext. limit, 8 yrs.
ditto	50	50	nil		
nigrum, L., var. chlorocarpum.	57	110	nil		
pseudocapsicum, L.	50	37	nil		
pungetium, R. Br.	57	83	nil		

	Years old.	No. of Seeds.	Per cent. Germ.	
simile, F. v. M.	56	200	nil	
sodomaeum, L.	51	105	1	
tomentosum, L.	15	20	nil	A. de C.
tuberosum, L.			many	D. After 70 days in sea water.
ditto			fewer	D. After 100 days in sea water.
ditto			nil	D. After 120 days in sea water.
Zuccagnianum, Dun.	15	20	nil	A. de C.
*Solidago, various sp.	20			Supp. age in soil.
Virgaurea, Linn.	12	250	nil	
ditto	25	200	nil	
Sonchus arvensis, Linn.	10	500	nil	
ditto	15	350	nil	
ditto	36?		few	Peter. Supp. time in soil.
ditto	45?		few	Peter. Supp. time buried.
ditto	50	250	nil	
oleraceus, Linn.	17	300	nil	
ditto	20?		few	Peter. Supp. time buried.
ditto	45?		few	Peter. Supp. time buried.
ditto	50	150	nil	
ditto	100?		few	Peter. Supp. age in soil.
Sorghum halepense, Pers.	17	100	nil	
vulgare, Pers.	12		nil	Nobbe.
ditto			many	D. After 30 days in sea water.
ditto			nil	D. After 50 days in sea water.

* Pharm. Journ and Trans., 3rd ser., x., 1879-1880, p. 601.

	Years old.	No. of Seeds.	Per cent Germ.	
Sparganium angustifolium, Michx.	57	100	nil	
ramosum, Curt.	1		some	Guppy. After 1 yr. in sea water.
simplex, Huds.	10	250	0.0	Fischer. Kept in clear water.
ditto	10	460	0.4	Fischer. Dried 1st year, then in water.
ditto	13		many	Fischer. After treatment with dil. acid.
Spartium junceum, Linn.	50	24	nil	
Specularia hybrida, A. de C.	60	1000	nil	
pentagonia, A. de C.			nil	Berkeley. After 30 days in sea water.
Spergula arvensis, L.	fresh		99	Nobbe.
ditto	5		85	Nobbe.
ditto	11		41	Nobbe.
ditto	59	76	nil	
ditto	67	150	nil	
Spergularia media, Presl.	1	97*	98.5	Duvel.
ditto	1	97*	96	Buried in soil.
ditto	15	20	nil	A. de C.
ditto	15	20	nil	A. de C.
media, Presl., var. heterosperma.	54	200	nil	
media, Presl., var. marginata.	69	150	nil	
rubra, Presl.	12	500	37	
rubra, Presl. (brevifolia), Wall.	57	100	nil	
Spermacoce rubra, Spreng.	15	20	nil	A. de C.
verticillata, L.	15	20	nil	A. de C.
Spilanthes Acmella, Murr (Para cress).	5	100*	50	Vilmorin. Ext. limit, 7 yrs.
Spinacia oleracea, L. (Spinach).	5	100*	50	Vilmorin. Ext. limit, 7 yrs.
ditto			many	D. After 70 days in sea water.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto			few	D. After 120 days in sea water.
ditto			nil	D. After 137 days in sea water.
Spinacia oleracea, L. (Round spinach).	5	100*	50	Vilmorin. Ext. limit, 7 yrs.
oleracea, Linn.	2	10	40	Rom. Air dried.
ditto	2	10	30-40	Rom. 1 yr. in O, H, N, CO or vacuo.
ditto	2	10	10	Rom. 1 yr. in H_2S.
ditto	2	10	20-40	Rom. 1 yr. in water, ether or chloroform vapour.
Spiraea amurensis, Maxim.	12	-1000	nil	
Aruncus, Linn.	43	-2000	nil	
ditto	46	-4000	nil	
ditto	59	-2000	nil	
ditto	62	-2000	nil	
canadensis, Fisch.	50	80	nil	
canescens, D. Don., var. indica, Hort.	50	130	nil	
Gieseleriana, Zabel.	50	22	nil	
inflexa, Hort.	50	54	nil	
salicifolia, Linn., var. famulata.	50	82	nil	
sorbifolia, Linn.	50	210	nil	
Spiranthes australis, Lindl.	57	-1000	nil	
Sporobolus airoides, Torr.	1		nil	Duvel. If buried, died.
cryptandrus, Gray.	1		nil	Duvel. If buried, died.
ditto	1	2*	3	Duvel. Buried deeply, 13.5 per cent.
indicus, R. Br.	49	200	nil	
indicus, R. Br., var. elongatus.	57	200	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Matrella, Nees.	55	52	nil	
Stachys annua, Linn.	15	20	nil	A. de C.
arvensis, Linn.	22	150	nil	
ditto	34	200	nil	
ditto	45?		few	Peter. Supp. time buried.
ditto	57	34	nil	
grandiflora, Benth.	40	500	nil	
libanotica, Benth.	52	75	nil	
nepetaefolia, Cav.	76		some	Becquerel.
sylvatica, Linn.	35	120	nil	
ditto	38	100	nil	
ditto	40?		few	Peter. Supp. time in soil.
ditto	50	200	nil	
ditto	300		nil	Nobbe. Old Herb.
Stachytarpheta angustifolia. Vahl.	15	20	nil	A. de C.
orubica, Vahl., var. aristata. Vahl.	15	20	nil	A. de C.
Stackhousia monogyna, Labill., var. linariifolia, A. Cunn.	37	30	nil	
spathulata, Sieber.	57	50	nil	
Statice reticulata, L.	55	110	nil	
spathulata, Desf.	15	20	nil	A. de C.
Stellaria aquatica, Scop.	53	100	nil	
graminea, Linn.	16	210	nil	
ditto	36?		few	Peter. Supp. time in soil.
ditto	41	200	nil	
ditto	50	88	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
media, Cyrill.	19	96	nil	
ditto	20?		few	Peter. Supp. time in soil.
ditto	27	140	nil	
ditto	45?		few	Peter. Supp. time buried.
ditto	50	210	nil	
ditto	67	64	nil	
ditto	100?		few	Peter. Supp. age in soil.
Stenanthera conostephioides, Sond.	57	22	nil	
Stenopetalum lineare, R. Br.	54	35	nil	
Sterculia quadrifida, R. Br.	14	30	nil	
Stevia ovata, Lag.	15	20	nil	A. de C.
Stipa aristiglumis, F. v. M.	57	46	nil	
elegantissima, Lab.	57	50	nil	
flavescns, Labill.	57	93	nil	
semibarbata, R. Br.	55	100	nil	
ditto	50	800	nil	
setacea, R. Br.	51	1000	nil	
Strongylodon lucidus, Seem.	fresh	5	20	Guppy. After 1 yr, on sea water.
Stylidium alsinoides, R. Br.	5	200	nil	
ditto, var. cordifolia.	22	1000	nil	
ditto	15	550	nil	
soboliferum, F. v. M.	50	56	nil	
Styphelia adscendens, R. Br.	57	30	nil	
Suaeda australis, Moq.	54	100	nil	Sand-p.
maritima, Dum.	55	131	nil	
ditto	15	20	nil	A. de C.

	Years old.	No. of Seeds.	Per cent. Germ.	
Subularia aquatica, L.	61	90	nil	
Sutherlandia frutescens, R. Br.	50	50	nil	
Swainsona galegifolia, R. Br.	12	12	8.3	Sw. in water.
		88	74	After 2 hr. in acid.
ditto	25	100	11	Sw. after 2 hr. in acid.
ditto	50	22	nil	
Greyana, Lindl.	50	36	nil	
Symphytum orientale, L.	50	16	nil	
Syncarpia laurifolia, Tenore.	8	200	58	Of sound, fertile seed.
ditto	10	2000	5.9	
ditto	38	250	nil	
ditto	38	250	nil	
leptopetala, F. v. M.	56	200	nil	
Synoum glandulosum, Juss.	57	12	nil	
Syringa Josikaea, Jacq.	50	22	nil	
vulgaris, Linn., var. purpurea.	50	18	nil	
vulgaris, Linn., var. rubra.	50	10	nil	
Tabernaemontana orientalis, R. Br.	10	100	nil	
ditto	47	100	nil	
Tanacetum vulgare, L. (Tansy).	2	100*	50	Vilmorin. Ext. limit, 4 yrs.
ditto	50	490	nil	
Taraxacum officinale, Weber., var, Dens-leonis, Desf.	24	30	nil	
officinale, Weber., var. erythrospermum, Andr.	1	86*	87.5	Duvel. Buried deeply, 45 per cent.
officinale, Weber. (Dandelion).	2	100*	50	Vilmorin. Ext .limit, 8 yrs.

	Years old.	No. of Seeds.	Per cent. Germ.	
officinale, Weber.	12	220	nil	
ditto	36?		few	Peter. Supp. time in soil.
ditto	50	180	nil	
ditto	57	70	nil	
ditto			many	D. After 61 days in sea water.
Tarrietia Argyrodendron, Bth.	10	35	nil	
ditto	57	20	nil	
Taxus baccata, Linn., var. fastigiata.	50	30	nil	
Tecoma australis, R. Br.	53	120	nil	All sw. in water.
ditto	55	150	nil	
Latrobei, F. v. M.	50	18	nil	
Telephium Imperati, Linn.	50	92	nil	
Templetonia egena, Benth.	9	80	2.5	
ditto	57	30	nil	All sw. in water.
retusa, Benth.	57	40	nil	
Tephrosia purpurea, Pers.	50	35	nil	
Tetragonia expansa, Murr. (New Zealand spinach).	4	100*	50	Vilmorin. Ext. limit, 8 yrs.
expansa, Murr., var. inermis.	57	12	nil	
expansa, Murr.	57	14	nil	
Teucrium Botrys, L.	57	73	nil	
Chamaedrys, L.	59	48	nil	
hircanicum, L.	15	20	nil	A. de C.
lancifolium, Boiss., var. asiaticum, Linn.	50	75	nil	
orientale, L.	15	20	nil	A. de C.

	Years old.	No. of Seeds.	Per cent. Germ.	
Scordonia, Linn.	10	150	nil	After $\frac{1}{2}$ hr. in acid.
ditto	10	250	nil	In acid 15 minutes.
ditto	10	300	nil	After 2 months moist.
ditto	10	250	nil	After 6 months moist.
ditto	55	80	nil	
sessiliflorum, Bth.	57	40	nil	
Thalia dealbata, Fras.	35?		some	Poisson. In soil.
Thalictrum angustifolium, Linn.	50	98	nil	
aquilegifolium, Linn.	15	20	nil	A. de C.
Cornuti, Linn.	67	146	nil	
flavum, Linn.	15	20	nil	A. de C.
glaucum, Desf.	50	32	nil	
ditto (densiflorum), H. B. and K.	15	20	nil	A. de C.
minus, Linn., var. elatum.	50	30	nil	
minus, Linn., var. pubescens.	50	31	nil	
Thespesia macrophylla, Blume.	35	25	nil	Sw. in water.
		45	2	Sw. after $\frac{3}{4}$ hr. in acid.
ditto	50	80	nil	Sw. after 2 hr. in acid.
Thlaspi alpestre, Linn.	15	20	nil	A. de C.
arvense, Linn.	1	57*	54	Duvel. Buried in soil, 11 per cent.
ditto	15	20	nil	A. de C.
ditto	20?		some	Peter. Supp. time in soil.
ditto	50	125	nil	
ditto	61	62	nil	
ditto	300		nil	Nobbe. Old Herb.
perfoliatum, L.	15	20	nil	A. de C.

	Years old.	No. of Seeds.	Per cent. Germ.		
Thryptomene Mitchelliana, F. v. M.	57	100	nil		
Thuya orientalis, Linn.	50	54	nil		
Thymus vulgaris, L. (French thyme).	3	100*	50	Vilmorin.	Ext. limit; 7 yrs.
Thysanotus Baueri, R. Br.	57	19	nil		
Patersoni, R. Br.	57	44	nil		
Tigridia Pavonia, Ker. Gawl.	15	20	nil	A. de C.	
Tillaea siberiana, Schult., var. verticillaris, D. C.	57	200	nil		
Tordylium cordatum, Poir.	15	20	nil	A. de C.	
Trachelium caeruleum, Linn.	50	850	nil		
Trachymene crassifolia, Benth.	54	50	nil		
heterophylla, F. v. M.	54	100	nil		
humilis, Benth.	57	37	nil		
incisa, Rudge.	50	45	nil		
lanceolata, Rudge.	57	200	nil		
pilosa, Sm.	57	34	nil		
Tragopogon crocifolius, Linn.	15	20	nil	A. de C.	
porrifolius, L.	50	35	nil		
porrifolius, L. (Salsify).	2	100*	50	Vilmorin.	Ext. limit, 8 yrs.
Tragus racemosus, Scop.	15	20	nil	A. de C.	
ditto	57	54	nil		
Trapa natans, L. (Water chesnut).	1	100*	50	Vilmorin.	Ext. limit, 2 yrs.
Tribulus terrestris, L. (acanthococcus).	57	35	nil		
Trichostema dichotomum, L.	50	50	nil		
Tricoryne elatior, R. Br.	37	20	nil		
ditto	57	90	nil		

	Years old.	No. of Seeds.	Per cent. Germ.	
elatior, R. Br., var. graminifolia, F. v. M.	55	35	nil	
Tricostularia pauciflora, Benth.	57	100	nil	
Tridax trilobata, Hemsl.			some	D. After 22 days in sea water.
Trientalis europaea, L.	57	45	nil	
ditto	57	70	nil	
Trifolium, sp. (Clover).	2	10	40	Rom. 1 year in O, CO or ether vapour.
ditto	2	10	10	Rom. Dried in air.
ditto	2	10	nil	Rom. 1 year in aqueous or chloroform vapour.
ditto	2	10	30-50	Rom. 1 year in vacuo. H or H_2S.
ditto	2	10	20	Rom. 1 year in N.
agrarium, L.	22	80	48	1 hr. in acid.
ditto	1400?		some	Brard. Seed from a Roman tomb.
alexandrinum, L.	12		nil	Nobbe.
ditto	15	20	nil	A. de C.
angustifolium, L.	49	56	nil	All sw. in water.
aristatum, Hornem.	15	20	nil	A. de C.
arvense, Linn.	15	20	nil	A. de C.
ditto	55	167	nil	All sw. in water.
		68	12	1½ hr. in acid.
ditto	67		some	Becquerel.
dubium, Sibth., var. minus.	50	200	nil	
elegans, Savi., var. caespitosum.	27		some	Becquerel.
filiforme, Linn.	19	50	32	½ hr. in acid.
fragiferum, L.	55	30	nil	All sw. in water.

	Years old.	No. of Seeds.	Per cent. Germ.	
globosum, L.	50	3	nil	
glomeratum, L.	13	100	39	All sw. after 1 hr. in acid.
ditto	17	100	2	All sw. after ½ hr. in acid.
ditto	20	100	25	All sw. after 1 hr. in acid.
ditto	53	140	nil	Sw. in water.
ditto		20	10	Sw. after 1 hr. in acid.
hybridum, L.	1	92*	84	Duvel. Of buried seed, 4.5 per cent. germ.
ditto	12		1	Nobbe.
incarnatum, Linn.	fresh		many	D. After 5 days in sea water.
ditto	fresh		some	D. After 12 days in sea water.
ditto	fresh		0.2	D. After 20 days in sea water
ditto	fresh		nil	D. After 30 days in sea water.
ditto	5	200	38	
ditto	10	200	11	After 1 hr. in acid.
ditto	12		nil	Nobbe.
ditto	42	88	nil	
ditto	50	82	nil	
ditto	55	43	nil	All sw. in water.
ditto	73	42	nil	All sw. in water.
intermedium, Guss.	70	18	nil	All sw. in water.
Lupinaster, L.	50	18	nil	
maritimum, Huds.	15	20	nil	A. de C.
ditto	59	50	nil	All sw. in water.
ditto	63	38	nil	All sw. in water.
Perreymondi, Gren. and Godr.	50	86	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
pratense, L.	1	89*	73	Duvel. Of buried seed, 4 per cent. germ.
ditto	fresh		87	Nobbe.
ditto	4		41	Nobbe.
ditto	15	20	nil	A. de C.
ditto	20	150	nil	
ditto	45?		few	Peter. Supp. time buried.
ditto	46?		few	Peter. Supp. age in soil.
ditto	50	120	nil	
pratense, L.	12		nil	Nobbe.
ditto	14	1000	4.6	2 hr. in acid. All sw.
ditto, var. expansum.	15	20	5-15	A. de C.
procumbens, L.	18?		few	Peter. Supp. age in soil.
ditto	54	50	nil	All sw. in water.
ditto, var. campestre, Sch.	300		nil	Nobbe. Old Herb.
ditto, var. minimum.	1400		some	Des Moulins. Seed from a Roman tomb.
ditto	14	100	3	
reclinatum, Wal. and Kit.	50	100	nil	
reflexum, Linn.	15	20	nil	A. de C.
repens, L.	1	85*	43	Duvel. Of buried seed, 1 per cent. germ.
ditto	fresh		50	Nobbe.
ditto	2		50	Nobbe.
ditto	12		nil	Nobbe.
ditto	14	1000	6.3	2 hr. in acid. All sw.
ditto	17	180	nil	
ditto	18?		few	Peter. Supp. age in soil.
ditto	32?		few	Peter. Supp. age in soil.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	36?		few	Peter. Supp. age in soil.
ditto	45?		few	Peter. Supp. age in soil.
ditto	100?		few	Peter. Supp. age in soil.
rubens, L.	15	20	nil	A. de C.
scabrum, L.	55	28	nil	All sw. in water.
ditto	56	47	nil	All sw. in water.
Sebastiani, Savi.	50	96	nil	
speciosum, Willd., var. Gussoni.	15	20	nil	A. de C.
spumosum, L.	15	20	nil	A. de C.
squarrosum, L.	61	100	nil	All sw. in water.
stellatum, L.	50	30	nil	All sw. in water.
ditto	54	32	nil	All sw. in water.
ditto	56	34	nil	All sw. in water.
striatum, L.	51	90	nil	All sw. in water.
strictum, Linn.	47	54	nil	Sw. in water.
ditto	47	120	11	Sw. after 1 hr. in acid.
ditto, var. laevigatum, Poir.	45	46	nil	Sw. in water.
		6	nil	Sw. after 1 hr. in acid.
subterraneum, L.	15	20	5-15	A. de C.
tomentosum, L.	50	10	nil	
tridentatum, Lindl., var. melananthum.	15	20	nil	A. de C.
Triglochin centrocarpum, Hook., var. nanum.	57	100	nil	
maritimum, L.	55	48	nil	
mucronatum, R. Br.	57	100	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
striatum, Ruiz. and Pav., var. decipiens.	55	100	nil	
Trigonella caerulea, Ser.	15	20	nil	A. de C.
ditto	50	64	nil	
Eretica, Boiss.	15	20	nil	A. de C.
Foenum-graecum, L.	12	78	5	All sw. in water.
ditto	50	23	nil	
polycerata, L.	50	35	nil	
ditto	50	130	nil	
ditto, var. pinnatifida, Cav.	50	83	nil	
spinosa, Linn.	15	20	nil	A. de C.
Triodia decumbens, Beauv.	16	120	nil	
irritans, R. Br.	57	80	nil	
procera, R. Br.	105	2000	nil	
Trisetum antarcticum, Trin.	57	200	nil	
ditto	54	62	nil	
ditto, var. muticum. F. v. M.	57	100	nil	
Tristania conferta, R. Br.	10	1000	nil	
Trithuria submersa, Hook. f.	57	120	nil	
Triticum vulgare, L. (Wheat).	fresh	100	68	1 day at 100 deg. C., dry.
ditto	1	99*	86	Duvel. Buried in soil; all died.
ditto	13	88	nil	
ditto	fresh	100	85	5 days in oxygenless water.
ditto	fresh	100	5	14 days in oxygenless water.
ditto	fresh	100	nil	21 days in oxygenless water.
ditto	fresh	100	nil	1 day in aqueous $HgCl_2$.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	fresh	100	10	After 1 days abs. alc.
ditto	fresh	100	2	After 21 days abs. alc.
ditto	fresh	100	nil	After 35 days abs. alc.
ditto	fresh	100	95	After 5 weeks in dry H and N.
ditto			many	D. After 1 month in sea water.
ditto			some	Schröder. Des. to 2 per cent. H_2O.
ditto	fresh	100	91	Des. 28 days to 2.67 H_2O.
ditto	1	100	96	Haberlandt.
ditto	3	100	60	Haberlandt.
ditto	5	100	4	Haberlandt.
ditto	8	100	88	Haberlandt.
ditto	12	200	nil	
ditto	12	300	1.7	
ditto	16	50	8	From Ch. of Commerce, S. Australia.
ditto	17	200	nil	
ditto	51	64	nil	
ditto	71	68	nil	
ditto	100		some	Stated by Hemsley.
ditto	10		0-10	Nobbe.
ditto	30		nil	Acton.
ditto	fresh		many	D.C. Cooled 100 times to about 50 deg. C.
ditto	3		most	Rohde.
ditto	1	100	100	Burgerstein. Dry in air.
ditto	4	100	94	Burgerstein. Dry in air.
ditto	7	100	85	Burgerstein. Dry in air.
ditto	10	100	75	Burgerstein. Dry in air.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	16		nil	Giglioli. In hydrogen.
ditto	16	50	nil	Giglioli. In H_2S.
Triumfetta annua, Linn., var. triclada.	15	20	nil	A. de C.
Tropaeolum majus, L. (Tall nasturtium).			most	D. After 37 days in sea water.
ditto			nil	D. After 50 days in sea water.
ditto	7	100	11	
ditto	50	30	nil	
ditto	5	100*	50	Vilmorin. Ext. limit, 6 yrs.
minus, L.	5	100*	50	Vilmorin. Ext. limit, 8 yrs.
pentaphyllum, Lam.	50	16	nil	
Tunica Saxifraga, Scop.	13	100	nil	
Tussilago Farfara, Linn.			few	D. After 25 days in sea water.
Tylophora barbata, R. Br.	57	32	nil	
Typha angustifolia, Linn.	57	1000	nil	
latifolia, Linn.	57	1000	nil	
ditto	ripe		nil	Coats intact. Crocker.
ditto	ripe		89	Coats broken. Crocker.
Ulex europaeus, Linn.			many	D. After 11 days in sea water.
ditto			few	D. After 14 days in sea water.
ditto			nil	D. After 28 days in sea water.
ditto	50	160	nil	
Urena lobata, Linn.	15	20	nil	A. de C.
Urospermum Dalechampii, F. Schmidt.	15	20	nil	A. de C.
Urticaceae.	25		nil	Becquerel.
Urtica incisa, Poir.	51	250	nil	
pilulifera, Linn.	15	20	nil	A. de C.
ditto	56	114	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
urens, Linn.	59	100	nil	
Utricularia tilacina, Griff.	55	50	nil	
Valerianella dentata, Pollich.	12	220	nil	
ditto	16	250	nil	
ditto	20?		few	Peter. Supp. age in soil.
ditto	36?		few	Peter. Supp. time in soil.
echinata, D. C.	50	15	nil	
eriocarpa, Desf. (Italian Cornsalad).	4	100*	50	Vilmorin.
olitoria, Pollich (Cornsalad).	5	100*	50	Vilmorin. Ext. limit, 10 yrs.
ditto	67	42	nil	
ditto (Large seeded Dutch).	5	100*	50	Vilmorin. Ext. limit, 10 yrs.
Velleia connata, F. v. M.	57	22	nil	
Verbascum Blattaria, Linn.	15	20	nil	A. de C.
ditto	57	500	nil	
phlomoides, Linn.	15	20	nil	A. de C.
pulverulentum, Vill., var. floccosum.	15	20	nil	A. de C.
virgatum, Stokes, var. blattarioides.	50	5000	nil	
Thapsus, Linn.	1	82*	98	Duvel. Buried deeply, 25.5 per cent.
ditto	15	20	nil	A. de C.
ditto	30		nil	Becquerel.
Verbenaceae.	25		nil	Becquerel.
Verbena hastata, Linn.	1	9*	5	Duvel. Buried deeply, 14 per cent.
officinalis, Linn.	10	100	nil	
ditto	15	20	nil	A. de C.

	Years old.	No. of Seeds.	Per cent Germ.	
urticifolia, Linn.	1	1.5	nil	Duvel. Buried deeply, 26.5 per cent.
ditto	15	20	nil	A. de C.
Verbesina encelioides, Benth. and Hook. f.	19	50	nil	
serrata, Cav.	15	20	nil	A. de C.
Vernonia urticaefolia, Rich.	55	32	nil	
Veronica agrestis, L.	18	160	nil	
ditto	20?		few	Peter. Supp. time in soil.
ditto	25	130	nil	
Anagallis, L.	61	250	nil	
arguta, R. Br.	57	50	nil	
arvensis, L.	20	85	nil	
ditto	20?		few	Peter. Supp. age in soil.
ditto	35?		few	Peter. Supp. age in soil.
ditto	50	120	nil	
calycina, R. Br.	57	200	nil	
didyma, Tenore., var. polita.	20?		few	Peter. Supp. time buried.
ditto	45?		few	Peter. Supp. time buried.
hederaefolia, L.	59	100	nil	
longifolia, L.	50	95	nil	
nivea, Lindl.	57	100	nil	
notabilis, F. v. M.	37	200	nil	
ditto	54	200	nil	
officinalis, L.	25	110	nil	
ditto	30	88	nil	
ditto	35?		few	Peter. Supp. age in soil.
ditto	50	140	nil	

	Years old.	No. of Seeds.	Per cent. Germ.		
ditto	60	132	nil		
ditto	100?		few	Peter.	Supp. age in soil.
peregrina, L.	57	100	nil		
perfoliata, R. Br.	55	38	nil		
scutellata, L.	55	92	nil		
serpyllifolia, L.	16	45	nil		
ditto	18?		few	Peter.	Supp. age in soil.
ditto	20?		few	Peter.	Supp. age in soil.
ditto	35?		few	Peter.	Supp. age in soil.
ditto	45?		few	Peter.	Supp. time buried.
ditto	57	34	nil		
ditto	100?		some	Peter.	Supp. age in soil.
Tournefortii, Gmel., var. Buxbaumii, Ten.	57	82	nil		
Viburnum dentatum, Linn.	50	18	nil		
ditto	61	72	nil		
Opulus, Linn., var. Oxycoccos.	50	15	nil		
pubescens, Pursh.	50	16	nil		
ditto, var longifolium.	50	11	nil		
Vicia angustifolia, Clos.	16	24	nil		
ditto	18?		few	Peter.	Supp. age in soil.
ditto	18	40	nil		
biflora, Desf.	15	20	nil	A. de C.	
bithynica, L.	64	18	nil	All sw. in water.	
Ervilia, Willd.	15	20	nil	A. de C.	
ditto	54	100	nil	All sw. in water.	

	Years old.	No. of Seeds.	Per cen Germ.	
Faba, L. (Broad-bean).	fresh	6	33	D. After 11 days in sea water.
ditto	fresh	6	nil	D. After 22 days in sea water.
ditto	6	100*	50	Vilmorin. Ext. limit, 10 yrs.
ditto	12		nil	Nobbe.
gemella, Crantz.	46	30	nil	Sw. in water.
		26	nil	Sw. after 1 hr. in acid.
gracilis, Loisel.	45	20	nil	A. de C.
grandiflora, Scop., var. sordida.	15	20	5-15	A. de C.
hirsuta, S. F. Gray.	45	40	nil	All sw. in water.
lutea, L.	55	20	nil	
monanthos, Desf.	3		50	Vilmorin. Ext. limit, 8 yrs.
narbonensis, L.	50	15	nil	
sativa, L. (vetch).			nil	D. After 5 days in sea water.
sativa, L. (grey).	12		nil	Nobbe.
sativa, L. (white).	11		nil	Nobbe.
sativa, L. (brown).	12		14	Nobbe.
ditto	16		nil	Giglioli. In hydrogen.
sicula, Guss.	50	19	nil	
tenuifolia, Roth.	45?		few	Peter. Supp. time buried.
ditto	50	52	nil	
unijuga, A. Br.	50	10	nil	
Vigna capensis, Walp.	15	20	nil	A. de C.
Catjang, Walp.	1	82.5*	nil	Duvel. Buried in soil, 1 per cent.
ditto	96	25	nil	All sw. in water.
ditto	10	40	35	Sw. in water.
ditto (Cow Pea, black).	10	50	66	

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto (Cow Pea, white).	12	50	nil	
ditto	10	50	40	Sw. in water.
ditto	9	50	70	All sw. in water.
glabra, Savi., var. niloticas, Del.	15	20	nil	A. de C.
ditto	48	8	25	Sw. in water.
		12	33	Sw. after 1 hr. in acid.
Villarsia parnassifolia, R. Br.	57	50	nil	
Viminaria denudata, Sm.	11	22	13.6	Sw. on soaking and 3 germ.
		128	80.5	Sw. after $2\frac{1}{2}$ hr. in acid, and 103 germ.
ditto	12	150	58	3 hr. in acid.
ditto	12	150	22	24 hr. in acid. 52 undissolved, of which 33 germinated.
ditto	18	68	7.3	After 2 hr. in acid.
		32	38	After addit. 2 hr. in acid.
ditto	50	33	nil	
Viola canina, L., var. montana, L.	50	108	nil	
odorata, L.	50	12	nil	
pinnata, Linn., var. dissecta.	50	42	nil	
Viscum album, L.	fresh		nil	Wiesner.
ditto	6 mths		100	Wiesner. Only germ. after winter rest.
Vitex Agnus-castus, L.	15	20	nil	A. de C.
Vitis vinifera, L.	fresh		some	Lefroy. After 1 week in sea water.
ditto	17	122	nil	
Vittadinia australis, Rich.	57	500	nil	
Waitzia corymbosa, Wendl., var. acuminata.	57	100	nil	

	Years old.	No. of Seeds.	Per cent. Germ.	
Watsonia aletroides, Ker. Gawl.	50	19	nil	
angusta, Ker. Gawl., var. fulgida.	50	14	nil	
Meriana, Mill.	50	44	nil	
ditto, var. iridifolia, Ker. Gawl.	50	15	nil	
ditto	51	15	13.3	
Westringia eremicola, Cunn.	55	50	nil	
Wiborgia obcordata, Thunb.	50	16	nil	
Wistaria Maideniana, F. M. Bailey.	10	7	43	6 hr. in acid. Cot. of another seed partly living.
Xanthima texanum, D. C.	50	6	nil	
Xanthium canadense, Mill.			some	Mart. After 93 d. fl. on sea water.
ditto, var. macrocorpum.			some	Mart. After 45 d. fl. on sea water.
pensylvanicum, Wallr.	1	50*	nil	Duvel. Buried in soil, 0.5 per cent.
spinosum, L.	57	60	nil	
Xanthostemon paradoxus, F. v. M.	51	100	nil	
Xerotes leucocephala, R. Br., var. typhina, Lindl.	47	50	nil	
sororia, F. v. M.	57	50	nil	
Zea Mays, Linn.			nil	Berkeley. After 1 month in sea water.
ditto	fresh	100	88	Des. 28 days to 2.5 per cent. H_2O.
ditto	fresh	100	80	Des. 56 days to 1.7 per cent. H_2O.
ditto	1	99.5*	99	Duvel. Buried; all died.
ditto	1	98.5*	98.5	Duvel. Buried; all died.
ditto	2		most	Rohde.
ditto	2	100*	50	Vilmorin. Ext. limit, 4 yrs.
ditto	1	100	96	Burgestein. Dry in air.

	Years old.	No. of Seeds.	Per cent. Germ.	
ditto	4	100	78	
ditto	4	50	48	From Hawkesbury Coll., N.S.W.
ditto	7	100	36	
ditto	10	100	2	
ditto	12		nil	Wiesner.
ditto	12		0-10	Nobbe.
Zinnia pauciflora, L., var. multiflora. L.	15	20	nil	A. de C.
Zoysia pungens, Willd.	54	200	nil	
Zygophyllum Billardierii, D. C.; var. ammophilum.	57	100	nil	
glaucescens, F. v. M., var. crenatum.	57	35	nil	
glaucescens, F. v. M., var. glaucum.	57	50	nil	
iodocarpum, F. v. M.	57	50	nil	
ditto	57	15	nil	

GENERAL SUMMARY.

The records of old seeds germinating fall naturally into two groups—(1) records where the seed is supposed to have lain dormant in the soil, the latter having been undisturbed (presumably); and (2) authentic records of stored or herbarium seeds. Even as regards the latter, some of the records seem to be incorrect (viz. *Phaseolus*), the seeds possibly having been inserted at a later date or the labels misplaced. The earliest complete records are those of de Candolle (*l.c.*), who found that out of 368 seeds kept dry in air for fourteen years only 17 retained a feeble germinative power, these including 5 out of 10 species of Malvaceae, 9 out of 45 species of Leguminosae, and 1 out of 30 Labiatae. De Candolle did not specially investigate the hard seeds on the list, and hence overlooked the fact that some of them (*Acacia*, *Medicago* and *Trifolium*) were probably germinable when softened.

Taking these precautions in an elaborate form by removing the integuments, sterilising and soaking, and keeping in moist sterile cotton wool, Becquerel considerably extended de Candolle's list, and found that 18 out of 90 leguminous seeds, those of 2 species of *Nelumbium*, of 1 Labiate and of 1 Malvaceae remained germinable for 25 to 80 years. The oldest germinable seed obtained by Becquerel were 3 species of Leguminosae 80 years old.

The various old Herbarium records are quoted in the alphabetical list, but do not require special mention. In regard to the records of seeds supposed to have lain dormant in the soil, these appear to be quite worthless, not more than two or three per cent. being confirmed by the authentic records of de Candolle, Becquerel and myself. It might be argued that the seed might last longer in the soil than when dried in air, but Duvel's comparisons of the germination of seeds buried in soil for a year, with the same preserved dry in air for a year, show that as a matter of fact the reverse is the case with all ordinary seeds. The only apparent exceptions appear to be with those hard seeds, which Duvel seems not to have known how to treat to induce germination.

The most complete set of soil records has been made by Peter (*l.c.*), by noting the appearance of plants in soil taken from forests of known age, without undergrowth, and in which the soil was supposed to have been undisturbed since the forest was planted. He found *certain* plants, mainly meadow and field weeds, continually appeared where a forest had covered meadow or field for 20 to 40 years, but mainly sylvan plants from still older forests, and hence concluded that the seeds in question had lain dormant in the soil during the life of the forest. This evidence has been accepted even in Pfeffer's Physiology, although the logic is childish in the extreme. In nearly every case, as can be seen from the lists, the seeds in question have a short duration of life, rarely exceeding five years, but they are all either small or readily dispersed by wind, or animals, thus reaching the forest land from neighbouring meadows, etc., and being covered more or less deeply by the activity of burrowing animals, ants, etc., or falling down cracks and burrows in the soil. If the matter were so simple as Peter imagines it to be, and these seeds were derived from the original vegetation prior to the forest, we should expect to find them more abundant some distance below the surface than on the latter itself. Those on the surface are more apt to germinate and decay, and Duvel has shown that the more deeply buried seeds last longer. In addition, the humus from 40 to 100 years of forestal growth would be sufficient to deeply cover the original surface. On the other hand, if the soil is continually receiving fresh supplies of seed from wind and water, or from the excrements, feet and bodies of birds and other animals, some of which seeds are buried from time to time by burrowing animals or washed down cracks, burrows or holes in the ground, we should naturally expect to find the surface richer in seeds than the deeper layers. Peter found germinable seeds down to a depth of 32 cms. (1 foot), but in only two cases were a few more seeds found at 8-16 cms. (3-6 inches) than on the surface, and the number 24 to 32 cms. deep was from 3 to 20 times less, and never greater than in the surface layer. Peter's observations are good evidence of the readiness of dispersal of certain seeds, but as evidence of their longevity are quite untrustworthy. They contain a grain of truth buried in a mass of inaccuracy. The same applies to all similar records of supposed old seed in soil

or under water being germinable, from the classical case of Mummy Wheat downwards. Here and there a long-lived seed has accidentally been hit upon, but in the great majority of cases the records are incorrect.

The Conditions for Longevity.

These are partly inherent in the seed itself, and partly due to the external conditions. As regards the latter, all observations agree that fairly cool, dry, airy conditions preserve seeds best, while in the soil seeds last longer in the deeper layers than in the surface ones. Seeds with impermeable coats are less dependent on the external conditions than ordinary ones, and may resist immersal in poisons or poisonous gases for years when dry and unswollen. Such seeds are naturally also most likely to last longest in the soil.

According to Fischer, however, the seeds of *Sagittaria* and similar plants may be kept under water for several years without losing the power of germination, and although the contents of the seed are moist. This is a far more remarkable fact than the long duration of certain seeds when dry, because in the former case there is a greater tendency to chemical change, and feeble respiration probably takes place.[1]

A few seeds (Willows, etc.), are killed by air drying, and according to Poisson[2] seeds of Cacao begin to die 36 hours after drying outside the fruit. In the case of all ordinary seeds, the drier the seeds the longer they are likely to last, and this applies more especially to starchy seeds.

The chief factor in longevity is the inherent character of the seed itself. In 1894[3] I showed that seeds capable of withstanding thorough drying assume a perfectly dormant condition in which they do not respire and are not living, although they have a power of restoring life potential in them for a longer or shorter period of years. Similar conclusions were made by de Candolle, who appears to have considered that all seeds, if carefully dried and preserved, would retain an indefinitely prolonged power of

1 Crocker (l.c.) has thrown considerable doubt on the correctness of Fischer's views.
2 Bulletin de la Soc. bot. de France, 1903, t. l., p. 337.
3 Ewart, Trans. Liverpool Biol. Soc., 1894, vol. viii., p. 234.
4 De Candolle, Archiv. d. Sci. phys. et nat: see also Nature, 1895, p. 348.

germination. This is, however, incorrect, and according to Becquerel, only those seeds can preserve their vitality for long periods of time which are protected by thick coats impermeable to water and oxygen, and which have feebly oxidizable reserve materials. This is, however, only a partial truth. It is a fact that "starchy" seeds last longer than oily ones, on the whole, but reference to the lists will show that many seeds containing appreciable quantities of oil are comparatively long lived (Myrtaceae, etc.) The truth is that long-lived (macrobiotic) seeds have mainly been developed among the Leguminosae, an order characterised by its starchy reserve food materials. Many more or less endospermic Leguminous seeds (*Melilotus*, *Cassia*, *Cytisus*, *Lotus tetragonolobus*, etc.), are macrobiotic, though incapable of the same duration as the non-endospermic seeds of *Goodia* and *Acacia*.

Longevity depends not on the food materials or seed coats, but upon how long the inert proteid molecules into which the living protoplasm disintegrates when drying, retain the molecular grouping which permits of their recombination to form the active protoplasmic molecule when the seed is moistened and supplied with oxygen. Chemical changes in the food materials might hasten the irrevocable disintegration which the slow process of time brings about, and in the same secondary manner the character and structure of the integuments will be of importance. The property of longevity is an hereditary peculiarity inherent in the protoplasm of certain seeds, and developed by natural selection as an adaptation to special conditions of life. According to Acton, samples of old wheat contained more soluble matter and less water than fresh wheat, while the diastatic and proteolytic ferments present in fresh wheat had entirely disappeared. This is, however, the result rather than the cause of death, since as long as the power of reconstituting the living protoplasmic molecule is present, the power of reproducing fresh ferments is retained.

Macrobiotic seeds are all seeds which show no special adaptations for dispersal. None are wind or water borne, and although some are more or less accidentally distributed by animals,

1 A full investigation of this question is in progress.

adhesive seeds or fruits are conspicuously absent among them. They are, in fact, distributed in time instead of in space. Falling to the ground beneath or close to the parent plant, a few are immediately germinable, but others only after long periods of years or after special actions have been brought to bear upon them.

Although a few seeds (*Phaseolus*, *Triticum*, etc.) with readily permeable coats may retain their vitality for many years in dry air, true macrobiotic seeds, adapted for prolonged duration in the soil, are always possessed of more or less impermeable coats, and they do not swell and germinate until these coats have been softened. Hiltner[1] was the first to show that hard clover seeds swelled readily after treatment with strong sulphuric acid, and this observation was extended and confirmed by Jarzymowski,[2] who showed that after appropriate treatment with strong sulphuric acid, followed by washing and neutralization with dilute ammonia or lime water, the percentage of clover seed germinating was higher than by any other form of treatment. Bergtheil and Day[3] then found that the hardness of the seeds of *Indigofera arrecta* was due to the presence of a very thin impermeable cuticle on the surface of the seed, and that when this was eaten away by half an hour's treatment with strong sulphuric acid, or broken, the seeds swelled readily. Miss White has investigated all the hard seeds, for which I found treatment with sulphuric acid necessary to bring about germination, and has detected in practically all such cases the presence of a cuticle of variable thickness. Her results are added to this paper in the form of an appendix.

Only in very few cases are seeds which do not absorb water except after filing or special treatment, not provided with a cuticle. One exception is afforded by *Adansonia digitata*, in which the whole integument seems to be permeable to water with difficulty. In almost all other cases any scratch deep enough to penetrate the cuticle allows the seed to absorb water and swell, and frequently the cuticle then frills or peels off as a transparent membrane. Hard seeds soaked in water for a day or so and then

1 Arb. aus der biol. Abt. f. Land. and Forst. wissenschaft, bd. iii., s. 30, 1902, Berlin.
2 Inaug. Diss. Halle, 1905.
3 Annals of Botany, vol. xxi., Jan., 1907.

placed in strong sulphuric acid often show the cuticle as a separate layer before it dissolves away. In a few cases the remaining integument may still delay the absorption of water, but not in the remarkable way that the cuticle does. In the case of most plants producing hard seed, a certain variable percentage of each sample will usually swell in water, and if the seeds are not perfectly ripe this applies to all of them, the cuticle being undeveloped or imperfectly developed. Such seeds perish rapidly in the soil, but in a dry herbarium may last for many years, though rarely as long as the perfectly ripe cuticularized ones, which swell only after breaking the cuticle by filing or destroying it by sulphuric acid. The importance of properly testing old hard seeds to obtain correct germination values is well shown by the following experiment. One hundred 50-year-old seeds of each of 5 Leguminous plants were placed in moist soil for 6 months in a warm house, and kept under optimal conditions for germination. None germinated, and with the usual modes of testing the samples would have been considered useless. The remaining hard undecayed seed were, however, taken up, the coats sand-papered, and the seeds placed in germination chambers, with the following results:—

—	Remaining seeds.	Number Germinating	Percentage of hard seed germinable.
Acacia armata	18	2	11
„ leprosa	7	3	43
Hardenbergia monophylla	10	5	50
Indigofera cytisoides	34	34	100
Watsonia viridifolia	6	1	17

The Treatment of Hard Seeds.—Since this is a matter of considerable practical importance, some detailed data are given of the experiments made upon it with Acacia seed.

The older idea that the impermeability of the coats was due to the presence of mineral matter is quite incorrect, as is also Jarzymowski's suggestion that it is connected with the small size of the lumina in the palisade layer of the integument. As Miss White has conclusively shown that the impermeability is bound up with the presence of a cuticular layer over the seed,

the only question is as to the best mode of removing that layer.[1] Scratching, filing, and such methods always tend to damage a certain percentage of the seed, besides being tedious even with the large seeds. The removal of the seed coats opens the embryo to the attacks of injurious soil organisms and causes a pronounced fall in the percentage of seed germinating.

Boiling with water soon injuriously affects the seed, although well dried Acacia seed is remarkably resistant to heat. Thus sound two-year seed of *Acacia longifolia*, *A. decurrens*, and *A. myrtifolia*, after heating to 98-100 deg. C. for 6 hours, filing and soaking, gave percentage germinations of 42, 35 and 31 respectively, the unheated seed giving germination values of 88, 46 and 52 per cent. respectively. After 2 days at 95 to 102 deg. C., however, none of the seed germinated. In warm water swelling is very slow. Thus a sample of 500 12-year-old seed of *Acacia dealbata* was soaked in water at 30-40 deg. C. for 10 days, and then at 40-50 deg. C. for a month, the swollen seeds being picked out every few days and placed in germination chambers.

Days.	No. of seeds swollen.	Number germinating.	% of swollen seeds germ.
3	43	1	2.3
6	34	nil	6.4
10	59	6	
13	85	5	5.9
17	58	5	8.6
21	50	14	28
31	38	1	4.3
33	29	2	
42	33	3	9

The 64[2] remaining seeds swelled at once after filing, and gave a percentage germination of 7.8 per cent. Hence the earlier seeds to swell are mostly dead, then the percentage germination rises and finally falls again, possibly as the result of the pro-

1 In some cases soaking in warm absolute alcohol makes the coats permeable to water, especially where the cuticle is thin, probably owing to the removal of the waxy materials impregnating the cuticle. Hot water, by melting the wax in the cuticle, aids in making the cuticle permeable.

2 Seven seeds had disappeared.

longed high temperature, although unswollen Acacia seeds can be kept a week or more under water at 60 to 65 deg. C. without entirely losing their vitality. Similar results were obtained with *Acacia myrtifolia*, but in all cases if the seeds were merely soaked for one to two days the remaining hard seeds, after filing or treatment with sulphuric acid, always gave a higher percentage germination than those which had swollen in water previously.

Alkali is much less effective than sulphuric acid in producing swelling without injuring the seeds. Thus of old seeds of *Acacia dealbata* soaked in water at 40 deg. C. for 2 days, 9 per cent. swelled, and of these 2.3 per cent. germinated. After soaking in 5 per cent. Na_2CO_3 for 1 day at 20 deg. C., and then 1 day at 40 deg. C. to 50 deg. C., in water, 45 per cent. swelled, and of these 5.2 per cent. germinated. After 1 minute in boiling 10 per cent. caustic soda, 28 per cent. swelled after frequent washing, and 3.4 per cent. of these germinated; while after 2 minutes in boiling potash, 78 per cent. swelled and 4.6 per cent. germinated. After 10 minutes all swelled, but none germinated. Longer treatment with cold caustic soda also produces swelling, but the difficulty of causing all the seeds to swell without injuring all or most of them is equally great. Ammonia is less effective than caustic soda or potash.

The 10 per cent. caustic soda or potash is useful, however, for seed testing. Thus, if an old sample of seed of *Acacia dealbata* is boiled for 2 minutes in the solution, washed well and soaked in water at 40-50 deg. C. for 3 hours or so, all unfilled, perforated or broken, seeds, and most dead seeds, swell up partially or entirely, and exude a dark brown dye. All, or the great majority of the sound seeds are still hard and unswollen. The test is not perfect, but will distinguish a good from a bad sample of Acacia seed.

The sulphuric acid treatment has this advantage, that the concentrated acid only penetrates slowly even after the cuticle has been dissolved away, and with careful treatment the whole of the subjacent layers are left intact. Further, it sterilizes the seeds and destroys all adherent spores. In addition germination is usually hastened as compared with seeds which have swelled without treatment. The chief danger lies in allowing traces of

acid to adhere to the seed, which is easily avoided by thorough washing, followed by treatment with dilute ammonia or lime water, and repeated washing. If then dried the seeds, whether Acacia, Clover, Broom, Gorse, or the like, are ready for planting and immediate germination. If the washing and drying are rapidly done the seeds do not swell, and will keep fairly well, whereas seeds softened by hot water must be planted at once. In dilute sulphuric acid the uncuticularized seeds soon lose the power of germination, and the cuticularized ones remain unsoftened. Hence the acid must only be applied to dry seeds.

The length of treatment with acid depends upon the extent to which the cuticle is developed, and as this varies in different samples of seed from the same plant, sample tests should be made before treatment, and the acid only used when the percentage of hard seeds is considerable. General data for different seeds are given in the main list, but a few detailed data for samples of very hard seed are given here, the usual washing and soaking in water following treatment with acid:—

Acacia dealbata.

Cold water	-	8 p. c. swelled in 2 days.
In acid, 5 minutes	-	10 ,, ,, ,, ,, in water.
,, 25 ,,	-	22 ,, ,, ,, ,, ,,
,, 2 hours	-	45 ,, ,, ,, ,, ,,
,, 3 ,,	-	66 ,, ,, ,, ,, ,,
,, 4 ,,	-	75 ,, ,, ,, ,, ,, 70 p. c. germinated.
,, 6 ,,	-	92 p. c. swelled in 2 days in water, 72 p. c. germinated.

After 6 hours some of the integuments were eaten right through, and the embryo exposed on washing, but such seeds may still be capable of germination in a germination chamber, though few would survive in the soil.

Similar results were obtained with samples of old very hard seed of *A. longifolia* and *A. decurrens*. For the smaller seeded Acacias, such as *Acacia montana*, *A. leprosa*, etc., 1 to 3 hours, and for such forms as *A. verniciflua*, 2 to 4 hours in sulphuric

acid is sufficient at 15 to 20 deg. C. to produce an optimal action on germination. As the temperature rises the action of the acid is more rapid; at 30 deg. C. it is about twice as active as at 20 deg. C. The acid must be concentrated. Slight dilution lessens the action greatly, and renders it more dangerous. During the longer soaking in somewhat diluted acid, the seeds are able to absorb the acid as the coats are acted on, whereas the strong acid keeps them dry and unswollen, and only such surfaces as the acid actually touches are corroded and destroyed.

Biologic Value of Hard Seeds.—As already mentioned, such seeds distribute themselves in time rather than in space, of each year's crop some being destined to remain germinable in the soil for very many years until the parent plants have been cleared off by fire or drought. In the case of *Callistemon rigida* and similar plants the seed is largely retained on the parent plant until fire or drought causes the death of the parent plant and the shedding of the seed, which may only take place when some at least of the seeds are 10 or 20 years old. In *Acacia*, *Viminaria denudata*, *Goodia lotifolia* and the like, the seed are shed, but lie in the soil. To some extent these macrobiotic seeds are adaptations to bush fires, which were probably of common occurrence long before the advent of civilised or even uncivilised man, and must have been far more frequent than at present when the lava was flowing from the volcanoes of Victoria.

Such bush fires, after burning off the humus more or less, not only partly expose the seeds, but leave behind an alkaline ash, which the next rain falling on the warm ground aids in softening the coats of the hard seeds, and bringing about their germination. When the ash is abundant and very alkaline the seedlings may be killed, but some will always survive. In addition, slight charring of the surface of the seed makes it permeable to water without necessarily destroying the vitality of the contents. The Acacias or other Leguminous plants, by the aid of their root-nodules, can grow in soil from which all, or nearly all, the humus has been burnt away, and the source of nitrates hence removed. They steadily enrich the soil again, and produce the conditions for the growth of large forest trees. These, if destroyed by a devastating bush fire, may once more be replaced by the humus forming Acacias, etc., whose seeds have lain

dormant in the soil during part, at least, of the growth of the forest.

I have, in fact, found Acacia seeds deeply buried in the soil of Gum forests, where no other signs of their presence could be seen, and where no other Acacias were present within at least a mile. In addition, the following data may be given of the number of germinable Acacia seeds per 2-inch cube of soil found at various depths under old Acacias growing in undisturbed primeval bush.

	Depth.	Seeds present in eight cub. inches.	Number germinable	Per cent.
Acacia dealbata	3 in.	28	26	93
	6 „	17	13	77
	9 „	16	10	63
	12 „	11	9	82
	18 „	3	3	100
A. stricta	4 „	1	1	100
	8 „	2	2	100
	12 „	0	0	0
A. leprosa	6 „	28	24	86
	12 „	15	14	93
A. melanoxylon	4 „	11	10	91
	8 „	5	4	80
	12 „	2	2	100
A. longifolia	6 „	2	2	100
var. *mucronata*	16 „	0	0	0
A. verticillata	4 „	32	26	81
	8 „	5	4	80
	12 „	4	4	100

A square pole of such soil would in the top 18 inches, in some cases, contain sufficient germinable seed to stock several square miles of territory, so that the amount of margin allowed for accident is very great, and even a very low percentage germination would suffice to re-cover the soil with the original vegetation after the severest bush fire. The percentage germinations are high, because as soon as the seed becomes permeable in the course of time and swells, it either germinates or dies, so that

in the deeper layers the only seeds found are likely to be hard macrobiotic ones. In fact, all the seeds found in the soil below the surface needed treatment with sulphuric acid to produce swelling and germination. Once they are swollen, the seeds are incapable of remaining long living in a latent condition without germinating, and this applies generally to the seeds of Leguminosae, whether cuticularized or not.

Conditions for Germination.—In addition to the usual statement that water, oxygen, and a certain temperature are needed, the proviso is required that the water and oxygen must be able to penetrate the seed in sufficient quantity. Even when a seed has absorbed water and swollen, it may remain dormant for a long time without dying if the supply of oxygen is deficient or the temperature low. Nobbe[1] and others have shown that the moist seeds of *Cirsium arvense, Papaver Rhoeas*, Cherry, Oak, etc., may remain alive without germinating for a year or more in the soil. Fischer[2] states that the same is the case with many water plants whose seed may remain germinable under water for years, though fully soaked. He finds that the seeds of *Sagittaria sagittifolia, S. platyphylla, Sparganium ramosum, S. simplex, Alisma Plantago, Potamogeton natans, lucens* and *pectinatus, Hippuris vulgaris, Polygonum amphibium, Scirpus lacustris* and *maritimus* germinate little, or not at all, in pure water, but readily if the water is allowed to foul and become sour, or if the seeds are acted upon by dilute acid or alkali (H and HO ions), especially at high temperatures. Thus after 2 hours in 0.3 mol. solution of acid at 40 deg. C., 75 per cent. germinated, whereas after 2 hours at 4-6 deg. C. only 3.4 per cent. germinated at the same subsequent temperature (25-27 deg. C.). Fischer considers that as the seed coat is permeable to water, salts and acid, the action must be a stimulating one exercised on the protoplasm of the seed by the hydrogen and hydroxyl ions. If so, the action might be suppressed by subsequent treatment with equivalent alkali after the acid. This is not the case. The treatment very possibly increases the permeability of the seed-coat to oxygen or water, and hence provides the requisite stimulus to germination. This explanation will suffice for all

1 Landw., Versuchsst, xx., p. 76.

2 Ber. d. D. Bot Ges., 1907, bd. xxv., p. 108

Fischer's results, and at any rate seeds of *Sagittaria* lightly sand-papered, and then kept at 28 deg. C. to 30 deg. C., between well-wetted filter paper, germinate readily. Since the above was written, Crocker (Bot. Gaz. 1907, p. 374) has shown that the difficulty of germinating the ripe seeds of various water plants is due not to any inherent dormancy of the protoplasm, but to the coats being imperfectly permeable, the seeds germinating readily when the coats are filed or broken. Fischer's treatment, i.e., the stimulation of H and HO ions, may perhaps enable the seed to germinate under the stimulus of a lower partial pressure of O and a lower temperature than otherwise, but is not an essential condition for germination, which, given a free supply of oxygen and a sufficient temperature and supply of moisture, appears to be readily induced in the case of *Sagittaria* at least. Correvon,[1] of Geneva, states that chemical stimuli, such as soaking in 0.25 per cent. acetic acid or 2 per cent. phosphoric acid is necessary for the germination of the seeds of *Juniperus Cedrus*, but all such actions may be the result of a change in the permeability of the coverings of the seed.

It must be remembered that in some cases at least seeds permeable to water are covered before germination by continuous semipermeable membranes. and such membranes may prevent the entry of the requisite amount of oxygen, while allowing water to enter. Thus A. J. Brown[2] has shown that the inner part of the intact spermoderm of *Hordeum*, *Avena*, *Triticum* and *Secale* forms a semi-permeable membrane which allows water and iodine to enter, but not solutions of sulphuric acid up to 36 per cent. strength, or of hydrochloric acid or metallic salts up to 5 per cent. (1 per cent. nitric acid penetrated slowly), and even after boiling the seeds or treating them with iodine, the sulphuric acid may still be unable to penetrate. Hence the semi-permeable membrane is in this case a non-vital one, and it appears to be that part of the spermoderm which is derived from the epidermis of the nucellus. It may, in fact, be something of the nature of an internal cuticle.

In the case of the paired burrs of *Xanthium*, one seed usually germinates in the first year, the second in the next year, or some-

1 Gard. Chron., 1907.
2 Annals of Botany, vol. xxi., 1907, p. 79.

times not till a year or two later. Crocker[1] considers that this is due to the greater impermeability of the seed coat of the later seed to oxygen. It is thicker than that of the earlier seed, and also more impermeable to water, though not sufficiently so to prevent its becoming fully saturated after a day's soaking. The double effect can be overcome by a temperature over 30 deg. C., which brings about partial anaerobic respiration, and by favouring the absorption of oxygen hastens germination. The minimum temperature for the germination of the naked seeds is 18 deg. C.

Crocker has, however, overlooked the fact that both the early and late seeds of *Xanthium echinatum* will germinate at 20 to 25 deg. C. if the temperature is maintained for 14 to 21 or more days, instead of for 8 or 9 days. Hence the temperature minimum for the germination of the later seeds is not as high as Crocker states (32-34 deg. C.). Further, if the burrs are heated to 40 deg. C. for a day, or to 50 deg. C. for a few hours while soaking, a variable percentage of the later seeds will germinate within 10 days. Hence the action of the intact integument is merely to delay and not to prevent the germination of the later seed at or near the minimum temperature for the earlier of each pair of seeds in the burr.

According to Crocker, Xanthium seed kept dry for 1 year, and still more if kept in soil, germinates more slowly at 18-22 deg. C. with the coats removed than do fresh burrs. This certainly does not apply generally, since in very many old seeds there is no perceptible delay in germination if the seeds are soaked and kept at the right temperature.

Light.—That in practice various small seeds must be superficially sown to germinate well, and that this is directly or indirectly due to their exposure to light is well known; but whether there are any seeds which, whatever the other conditions may be, will not germinate unless exposed to light, is uncertain.[2] Seeds of *Viscum album* apparently only germinate when exposed to light (Wiesner), and the same applies to the seeds of Tobacco, according to Raciborski, and to those of *Poa pratensis* and *Apium graveolens* when fresh, according to Kinzel,[3] whereas

1 Bot. Gazette, 1906, p. 273.
2 For lit. see Pfeffer's Physiol., Eng. Ed., vol. ii., p. 82.
3 Kinzel, Ber. d. D. Bot. Ges., 1907, bd. xxv., p. 269.

when older these seeds will germinate in darkness. On the other hand, certain seeds, such as those of *Nigella sativa*, *N. damascena*, *Allium* and *Asphodelus* were found by Kinzel to refused to germinate when exposed to strong light, and appeared to permanently lose their vitality if the exposure was prolonged. Further, if these seeds were exposed to one day's gaslight after being 1 day moist in darkness, their germination was stopped, and could only be reawakened by treatment with proteolytic enzymes after drying and re-moistening, aided by aeration and high temperatures. Kinzel followed Acton's conclusion that the loss of the power of germination was due to the destruction of the enzymes contained in the seed, but the evidence is not such as to warrant this conclusion, and the observation that treatment with enzymes may increase the percentage germination of certain old seeds[1] may be the result of error or of an action on the seed coats. Jodin,[2] in fact, denied that light affected either the vitality or the germination of seeds, whereas Laurent[3] concluded that it retarded germination and injured the vitality of resting seeds.

Delayed Germination and After Ripening.—According to Wiesner,[4] seeds of Viscum are ripe in autumn, but will only germinate the following spring. There is no visible change in the seed, but Wiesner supposes that during this time a production of ferment takes place which prepares the way for germination. Goebel[5] mentions that certain early flowering plants have seeds which contain immature embryoes. These slowly enlarge and ripen during summer, and are ready to germinate or to complete germination in the following spring. This applies to the seeds of *Eranthis hyemalis*, *Ranunculus Ficaria*, *Anemone Corydalis*, and possibly also *Stylidium*, *Gagea* and *Erythronium*. These seeds apparently have no resting period, but mature slowly up to the time of germination.

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1 Thompson, Garten flora 45, 344, 1896; Waugh, Ann. Rpt. Vt. Agr. Exp. St. 1896-7;. Science, iv., s. 6, 950, 1897: Sharpe, Mess. Hatch. Exp. St., 1901, p. 74. See also Albo Archiv. Sci. Phy. et nat., 25, 1908, p. 45.

2 Compt. rend., t. cxxxv., p. 1229. See also Tamme, Landw. Jahrb., 1900, bd. xxix., p. 467.

3 Compt. rend. t. cxxxv., pp. 1091, 1293.

4 Biol. de Fflanzen, 1902, p. 55.

5 Organography, ii., p. 249, 1905.

Nobbe and Hanlein[1] found that a large number of seeds, although soaked, only germinated after long intervals of time (3 years in some cases), and considers that this is due to some change taking place slowly in the embryo during rest. The delay was, however, merelv due to the low temperature. All the seeds in the list, when soaked, provided with oxygen and kept at 25-30 deg. C., begin to germinate in 1-30 days after absorbing water. Further, it is impossible to keep any of these seeds at a suitable germination temperature (20-30 deg. C.) without their decaying long before 3 years have elapsed. Even if they are frequently washed, which does not appear to have been done by the authors, in nearly all cases signs of decay can be seen within a month of soaking if the temperature is above 20 deg. C., and usually before this. The fact that Nobbe and Hanlein found 9 out of 31 seeds gave germination percentages of nil or below 1 per cent. is sufficient to show that they did not work under proper conditions, for the plants mentioned are freely seeding ones, and two of them, *Verbascum nigrum* and *Plantago major*, gave percentages of 42 and 64 per cent. within 3 weeks on germinating soaked seed at 25-30 deg. C.

Nobbe and Hanlein found that seeds of *Chenopodium album* and *Chelidonium majus* mostly remained in the soil for 1 year, and some for 3 years before germinating. Here, again, all properly soaked seeds kept at 25-30 deg. C. and freely aerated, germinate within a month, and by that time all the dead soaked seeds are distinctly decayed.

Various observers have stated that seeds of *Cucurbita* and *Allium* germinate more readily and abundantly after keeping a year or more, or warming for a time, than when fresh. This certainly does not apply to all samples of seed, and hence it is not easy to say whether we are dealing with a manifestation of after ripening, or with some changes in the character of the seed coats. In some of the seeds examined by Duvel the fresh seed gave a lower percentage germination than the same seed examined a year later; but this may have been due to imperfect methods. Such results as those for *Lactuca Scariola*, for instance, are obviously inaccurate, and in many cases Duvel

1 Landw., Versuchsst, 1877, p. 63, 1880, p. 465.

gives widely different percentages for the same seeds according to whether they were germinated in a green-house or in a control chamber, the percentages being sometimes much higher and sometimes much lower in the latter case than in the former. This can only be due to inaccurate work, and the same explanation possibly applies to the fact that the year-old air-dried seeds, and in some cases the buried ones, gave higher percentages than the same seeds when originally tested. Duvel took no precautions to meet the case of hard, non-swelling seeds, and in some cases at least the seeds in question were ones with hard or more or less cuticularized coats. The weathering, softening, or abrasion of the seed coats (or fruit-walls) by rendering them more permeable to water and oxygen, might easily cause a higher percentage germination of the older seed. This is, however, not a true case of after-ripening, which is strictly a vital process taking place in the living contents of the seed. In other cases where seeds are supposed only to germinate after being dried, the drying appears to act by causing cracks to appear in an otherwise impermeable integument. Crocker (*l.c.*) has, in fact, shown that several cases of delayed germination supposed to be due to after-ripening are really due to the impermeable properties of the seed coats. Thus *Ascyris amaranthoides* has dimorphic seeds, consisting of (a) flattened winged forms with permeable coats, which germinate readily, and (b) rounded forms with impermeable coats, which germinate only after considerable delay unless the seed coats are broken. In the case of *Abutilon Avicenniae* and *Chenopodium album*, the seed coats of otherwise similar seeds are unequally permeable, some swell at once, others only after prolonged soaking. The same is the case with the seeds of the Leguminosae in the foregoing lists. The "hard" seeds are usually smaller than the readily swelling ones, but this is simply because they are drier; when swollen the sizes are approximately the same, and in the act of swelling many of the "hard" Acacia seeds often increase by 2 to 4 times the original bulk.

In the case of *Plantago major*, *P. Ruegelii*, *Thlaspi arvense* and *Avena fatua*, the delay in germination is also due to the seed coats, and can be overcome by removing or breaking them. When they are intact the minimum temperature for the germina-

tion of the first 3 seeds is above 22 deg. C., which would explain Nobbe and Hanlein's results with these seeds. The seeds of Hawthorn are supposed not to germinate until after a year in the soil. Crocker obtained no definite confirmation or negation of this fact, but here also it appears to be a case of the slow disintegration of the seed coats.

The Condition of Resting Seeds.—The old idea that the complete suppression of every form of vital activity necessarily involved irrevocable death, led to the assumption that in resting seeds respiration continued, though at a very low ebb. Jodin[1] showed, however, that 20 peas containing as much as 11 per cent. of water, and linseed containing 12 per cent., produced a mere trace of carbon dioxide in four years. Kolkwitz[2] has recently shown in the case of Barley how rapidly the amount produced decreases as the percentage of moisture decreases.

Barley.—

Weight of seed.	Temperature.	Percentage of water.	CO_2 produced per 24 hours.
1 Kilogram	Summer	19-20 p. c.	3.59 mg.
,,	,,	14-15 ,,	1.4 ,,
,,	,,	10-12 ,,	.35 ,,
,,	50 deg. C.	10-12 ,,	15.0 ,,

Becquerel[3] finds that air-dried seeds give off small traces of carbon dioxide, and absorb traces of oxygen. Exposure to light increases this action, and the gaseous exchanges from the integuments of *Ricinus* are greater than from the seed from which they have been removed. Obviously here we are dealing with extraneous chemical oxidations not connected with vitality. In fact, the drier the seed the less the "respiration," and in seeds capable of withstanding extreme desiccation the absence of moisture entirely prevents all gaseous exchanges. A priori this must be the case in all dry seeds covered with a continuous impermeable cuticular layer. Thus no perceptible evolution of carbon dioxide could be detected from clean dry samples of Acacia seed containing less than 5 to 8 per cent. of water

1 Compt. rend. d. l'Acad. des Sciences, t. 122, p. 1349, 1896.
2 Ber. d. D Bot. Ges., 1901, vol. xix., p. 285.
3 Comptes rendus, t. cxliii., 1906, p. 974.

(*A. dealbata, longifolia*). Such seeds when preserved in a dry atmosphere seem to steadily lose water until ultimately as dry as if kept in a desiccator. It is as though the cuticle allowed traces of water to escape externally, but none to enter. Thus fresh air-dried Acacia seed contained 5 to 14 per cent. of moisture, whereas 10 to 20-year-old seed of *A. myrtifolia, A. longifolia, A. armata* and *A. dealbata* contained only from 0.9 to 3.2 per cent., and 50-year-old seed of *A. myrtifolia* and *A. longifolia*, after heating to 100 deg. C. for half an hour to drive off adherent moisture, lost no further weight after 3 days at 100 deg. C., and only 0.7 per cent. after 1 day at 110 deg. C. Fine capillary glass tubes show a greater loss of weight than this, owing to the adherence of condensed moisture, more especially to their internal surfaces. Hence old dry cuticularized macrobiotic seeds become drier than corresponding inorganic material. However dry the seeds may be, they cannot indefinitely prolong their vitality. Even the most resistant seeds after 50 to 100 years show a pronounced decrease in the percentage germination, and the general trend of the curves is such as to show that the probable extreme duration of vitality for any known seed may be set between 150 and 250 years (Leguminosae). Probably the maximal duration for Malvaceae and Nympheaceae lies between 50 and 150 years, while for Myrtaceae and the orders containing only one or two macrobiotic seeds it is doubtful whether the limit appreciably exceeds 50 years. Even when perfectly inert a macrobiotic seed is subject to slow and gradual molecular changes and rearrangements, such as take place in glass or wood in the progress of centuries, and these changes cannot take place in the contents of the seed without destroying the molecular arrangements and groupings requisite for the restoration of life. Once this has taken place no ferment, no physical or chemical condition can bring about germination.

General Summary of Tabulated Results.—For purposes of convenience we may divide seeds into 3 biological classes, according to their duration of life under optimal conditions. These are short lived or MICROBIOTIC seeds whose duration does not exceed 3 years, MESOBIOTIC seeds which may last 3 to 15 years, and MACROBIOTIC seeds which may last from 15 to over 100 years. The first two are the more numerous groups, and the boundary

between them is somewhat ill-defined. Occasionally seeds such as wheat or barley, which are really mesobiotic, may come close to, or even under special conditions pass the limit of, 15 years, but since they are usually dead by this time they come properly under the head of mesobiotic seeds. The macrobiotic seeds are less numerous, are characterised by cuticularised or more or less impermeable seed coats, and are restricted to a few natural orders, of which the Leguminosae greatly surpass all others while Malvaceae and Myrtaceae come next in importance. Here again a few seeds come into this class which, under natural conditions, do not belong to it, since only seeds which have impermeable coats can survive for long periods of time in the soil.

MACROBIOTIC SEEDS.

Leguminosae.

Acacia acinacea
alata
aneura
armata
bossiaeoides
brachybotrya
calamifolia
cornigera
dealbata
decurrens
diffusa
Doratoxylon
elata
farnesiana
glaucescens
lanata
lanigera
leprosa
longifolia
melanoxylon
montana
myrtifolia
neriifolia
nervosa
penninervis
pentadenia
saligna
Simsii
suaveolens
verniciflua
Albizzia lophantha
Alhagi camelorum
Astragalus Antiselli
brachyceras
glycyphylloides
Bossiaea heterophylla
Caesalpinia Bonducella
Canavalia ensiformis
obtusifolius
Cassia australis
bicapsularis
Brewsterii

laevigata
pleurocarpa
Sophera
Cicer arietinum
Coronilla Mitchelli
laburnifolia
ramosissima
vitellina
Cytisus albus
austriacus
biflorus
candicans
triflorus
Daviesia cordata
corymbosa
crenulata
Desmanthus brachylobus
Dillwynia ericifolia
floribunda
(?) Dioclea parviflora
Dolichos funarius
Erythrina indica
Vespertilio
Eutaxia orientalis
Galega orientalis
Genista anglica
Spachiana
Gompholobium latifolium
minus
Goodia lotifolia
Hardenbergia monophylla
Hovea heterophylla
linearis
longifolia
Indigofera australis
cytisoides
signata
Jacksonia spinosa
thesioides
Kennedya monophylla
prostrata
rubicunda
Lens esculenta
Leucaena leucocephala
pulverulenta
Lotus corniculatus
tetragonolobus
Medicago denticulata
lupulina
sativa
scutellata
truncatula
Melilotus alba
Bonplandi
gracilis
messaniensis
officinalis
parviflora
Mimosa asperata
distachya
glomerata
pudica
Mirbelia oxyloboides
reticulata
Oxylobium Callistachys
cuneatum
ellipticum
lineare
parviflorum
trilobatum
Phaseolus Mungo
pilosus
Phylacium bracteosum
Pithecolobium pruinosum
Podalyria calyptrata
sericea
Psoralea pinnata
Pultenaea baeckeoides

daphnoides
retusa
stipularis
villosa
Rhynchosia minima
Swainsona galegifolia
Trifolium agrarium
arvense
elegans
filiforme
glomeratum
pratense
strictum
subterraneum
Vicia grandiflora
Vigna glabra
Viminaria denudata

MALVACEAE.

Abutilon Avicennae
(?) indicum
(?) Mitchelli
oxycarpum
Gossypium Sturtii
Hibiscus heterophyllus
panduraeformis
Trionum
Kitaibelia vitifolia
Lavatera arborea
cretica
plebeia
Malva rotundifolia
Malvastrum vitifolium
Modiola multifida

MYRTACEAE.

Callistemon lanceolatus
rigidus
Eucalyptus calophylla
cornuta
diversicolor
globulus
goniocalyx
Eucalyptus leptopoda
miniata
obcordata
punctata
rostrata
tereticornis
Leptospermum scoparium

NYMPHEACEAE.

Nelumbium luteum
speciosum
Nymphaea gigantea

LABIATAE.

Nepeta botryoides
Stachys nepetifolia
Nepeta Cataria

IRIDEAE.

Iris sp.
Watsonia Meriana

EUPHORBIACEAE.	POLYGONACEAE.
Euphorbia Peplus	Emex spinosa.
GERANIACEAE.	STERCULIACEAE.
Impatiens Balsamina.	Hermannia angularis.
GOODENIACEAE.	TILIACEAE.
Scaevola Hookeri.	Entelia arborescens.

APPENDIX.

The Occurrence of an Impermeable Cuticle on the Exterior of Certain Seeds.

BY JEAN WHITE, M.Sc.

(Government Research Scholar).

Whenever possible, Professor Ewart passed on to me specimens of those seeds which he found needed special treatment before they were capable of imbibing water, and consequently swelling. For the investigation of the cause of this impermeability a method was adopted which was somewhat similar to that employed by Bergtheil and Day in their researches on the hardness of the seeds of *Indigofera arrecta.*[1] The great majority of the seeds which exhibited this resistance were from plants belonging to the family *Leguminosae.* In several of the *Malvaceae,* the same phenomenon was observed, and also in a somewhat doubtful case of a species of *Chenopodium.*

Method of Experimenting.—The seeds were soaked in water for a time, varying from one to seven days.

In the majority of cases none of the seeds swelled, though commonly a small proportion did so, and in a very few instances, practically all swelled, so that it was quite difficult to obtain unswelled specimens for investigation. The unswelled seeds

1 Annals of Botany, vol. xxi, Jan., 1907.

were removed from the water, and hand sections were cut of the seed-coat. These sections were stained on the slide with chlor-zinc-Iodine, and the stain, after remaining for one to two minutes, was washed off with glycerine water. Examination of the sections showed that in every instance, almost without exception, a structureless cuticle was observable on the exterior of the seed coat. The cuticle was clear and well defined, becoming stained bright yellow, while the cell-walls of the subjacent palisade tissue assumed the characteristic violet or bluish tint of cellulose. The internal contents of these cells were, like the cuticle, stained yellow. In nearly all cases sections were also prepared from the swelled specimens, disclosing the fact that in some no cuticle at all was developed, presumably due to the immature condition of the seeds; whilst in others the cuticle appeared to be well developed, indicating that the seed had been injured and the cuticle broken at some point or points, rendering it permeable at that point or points.

In every instance the cuticle was easily distinguishable when stained with chlor-zinc-iodine, but Bergtheil and Day were unable to discern the cuticle in the seeds of *Indigofera arrecta* when using this reagent, and in order to render the cuticle visible they employed a solution of Iodine in Phosphoric acid. Following on their method, I made up some of this stain, but though the results were always satisfactory, in no instance was the differentiation so complete as when chlor-zinc-iodine was used. This suggested the possibility that the chlor-zinc-iodine solution used by Bergtheil and Day might not be of the correct consistence, and I obtained seeds of *Indigofera arrecta* in order to test them with my solution. I found that I obtained the same results as when the other seeds were used, so that it was evident that the chlor-zinc-Iodine solution used by Bergtheil and Day was at fault. A distinct cuticle was present in the *Indigofera arrecta*, whilst there was no trace of a cuticle structure in the sections of *Indigofera sumatrana*, treated with chlor-zinc-iodine solution.

In some of the seeds examined, notably those of *Labichea lanceolata*, the whole of the structureless cuticle did not appear to be specially resistent, but there was a narrow edge on the free side of the cuticle which stained a deeper yellow, and which on treatment with strong sulphuric acid, disintegrated into seg-

ments. It appeared to be in this edge that the extreme impermeability of the seed coat was located.

The variations in the resisting powers of the different seeds are very curious, and as will be noticed in the accompanying tables, the thickness of the cuticle does not seem to be solely responsible in determining the powers of resistance to swelling. Naturally the quality and degree of impregnation of the cuticle is as important as its thickness. As an example of this a few cases of different species of Acacia may be cited.

Thus the thickness of the cuticular layer of *Acacia diffusa*, as measured by the eyepiece micrometer was .042 mm.. whilst that of *Acacia glaucescens* was .022 mm. In the former case soaking for 0.5 hours in acid was sufficient to produce swelling of the seeds when put into water; but in the latter case none of the seeds swelled in water unless they had been previously soaked in sulphuric acid for 1.5 hours.

As a general rule in small and medium-sized seeds, the cuticle is well developed, and represents the impermeable part of the seed coat, while in the case of large seeds, such as those of *Adansonia Gregorii*, *Mucuna gigantea*, *Wistaria Maideniana* and *Guilandina Bonducella*, the cuticle is relatively unimportant and inconspicuous. In these seeds the extreme resistance which they exhibit appears to be located in the palisade cells. The above conclusions were arrived at as a result of further experiments which were carried out with the seeds.

The unswelled seeds, after several days' soaking in water, were placed in strong sulphuric acid and left there for about 15 minutes. They were removed, and again placed in water, in which they remained for a day. Immersion for 15 minutes in nearly every case proved to be insufficient to render them permeable, and consequently they were replaced in the sulphuric acid for 10 or 15 minutes again. Half an hour's immersion in the acid was found to be adequate for most of the seeds, there being a small minority which required further soaking in acid for 15 to 60 minutes longer. The minimum times required for the different varieties of seeds to be soaked in acid before they are capable of imbibing water are stated in the accompanying tables. Directly a seed was seen to have swelled in water, a section of the seed coat was cut, with the result that in the

majority of smaller seeds the palisade layer was observed to be quite intact, whilst the cuticle had been in some cases wholly, but in the greater number of cases partially, dissolved away by the acid.

But it was different with the larger seeds; for sections of the seed coat cut after swelling showed that the palisade tissue was eaten away by the acid, and ordinarily it was practically all gone.

Before and during swelling, almost without exception, a membrane peeled off the seeds, which in the smaller seeds appeared to be the cuticular layer only, and in the larger consisted of the palisade cells and the very inconspicuous cuticle.

The most resistent seed of all those which I tried was that of *Adansonia Gregorii*. Professor Ewart found that his specimens swelled after 6 hours soaking in sulphuric acid, but in the case of a different sample with which I experimented, immersion in acid for that period of time produced no perceptible effect whatever.

The actual results of my experiments have been put down in a tabular form, and the accompanying figures represent sketches of the sections of the seed coats of one species of each genus of most of the seeds used.

Name of Seed.	*Minimum time in sulphuric acid to produce swelling.	Thickness of cuticle.
Abutilon oxycarpum	.5 hours	.030 mm.
Acacia brachybotrya	.42 ,,	.019 ,,
Acacia calamifolia	1 ,,	.060 ,,
Acacia diffusa	.5 ,,	.042 ,,
Acacia glaucescens	1.5 ,,	.022 ,,
Acacia iteaphylla	.5 ,,	.005 ,,
Acacia leprosa	.5 ,,	.015 ,,
Acacia longifolia	1 ,,	.030 ,,
Acacia montana	.42 ,,	.015 ,,
Acacia myrtifolia	1 ,,	.019 ,,
Acacia penninervis	.75 ,,	.030 ,,
Acacia retinodes	1 ,,	.018 ,,
Acacia verniciflua	.42 ,,	.016 ,,

* In practically all cases the time of immersion can be doubled or more than trebled without appreciable injury to the seed, the subsequent swelling in water being naturally more rapid.

Adansonia Gregorii - -	6? hours -	.012 mm.
Albizzia lophantha - -	.5 ,, -	.011 ,,
Albizzia pruinosa - -	1 ,, -	.011 ,,
Albizzia Saman - - -	.5 ,, -	.026 ,,
Alhagi camelorum - -	.5 ,, -	.002 ,,
Barklya syringifolia - -	.4 ,, -	.011 ,,
Bossiæa heterophylla - -	.5 ,, -	.012 ,,
Bossiæa Stephensoni - -	.5 ,, -	.011 ,,
Canavallia obtusifolia - -	.42 ,, -	.003 ,,
Cassia australis - - -	.25 ,, -	.041 ,,
Cassia Brewsterii - -	.25 ,, -	.042 ,,
Cassia eremophila - -	.25 ,, -	.012 ,,
Cassia laevigata - - -	.25 ,, -	.008 ,,
Cassia suffruticosa - -	.25 ,, -	.009 ,,
Ceratonia siliqua - -	.25 ,, -	.009 ,,
Chenopodium album - -	? ,, -	.012 ,,
Crotalaria Mitchellii - -	.5 ,, -	.018 ,,
Cytisus albus - - -	.5 ,, -	.004 ,,
Cytisus triflorus - -	.5 ,, -	.005 ,,
Daviesia parviflora - -	1.5 ,, -	.002 ,,
Dillwynia ericifolia - -	1.5 ,, -	.003 ,,
Dillwynia floribunda - -	1.5 ,, -	.003 ,,
Dolichos sinensis - -	.42 ,, -	.002 ,,
Erythrina Vespertilio - -	.75 ,, -	.002 ,,
Gompholobium latifolium -	.20 ,, -	.013 ,,
Goodia lotifolia - - -	1.42 ,, -	.022 ,,
Guilandina Bonducella -	1 ,, -	? ,,
Hibiscus heterophylla -	1 ,, -	.008 ,,
Hibiscus Lampas - -	1 ,, -	.026 ,,
Hibiscus tiliaceus - -	.42 ,, -	.019 ,,
Hibiscus Trionum - -	.5 ,, -	.023 ,,
Hovea heterophylla - -	.42 ,, -	.020 ,,
Hovea longifolia - -	.5 ,, -	.023 ,,
Indigofera arrecta - -	.5 ,, -	.008 ,,
Kennedya monophylla -	1.5 ,, -	.002 ,,
Kennedya prostrata - -	1.5 ,, -	.013 ,,
Kydia (Bastardia) caracas -	.5 ,, -	.005 ,,
Labichea lanceolata - -	.42 ,, -	.044 ,,
Lablab purpureus - -	.5 ,, -	.030 ,,

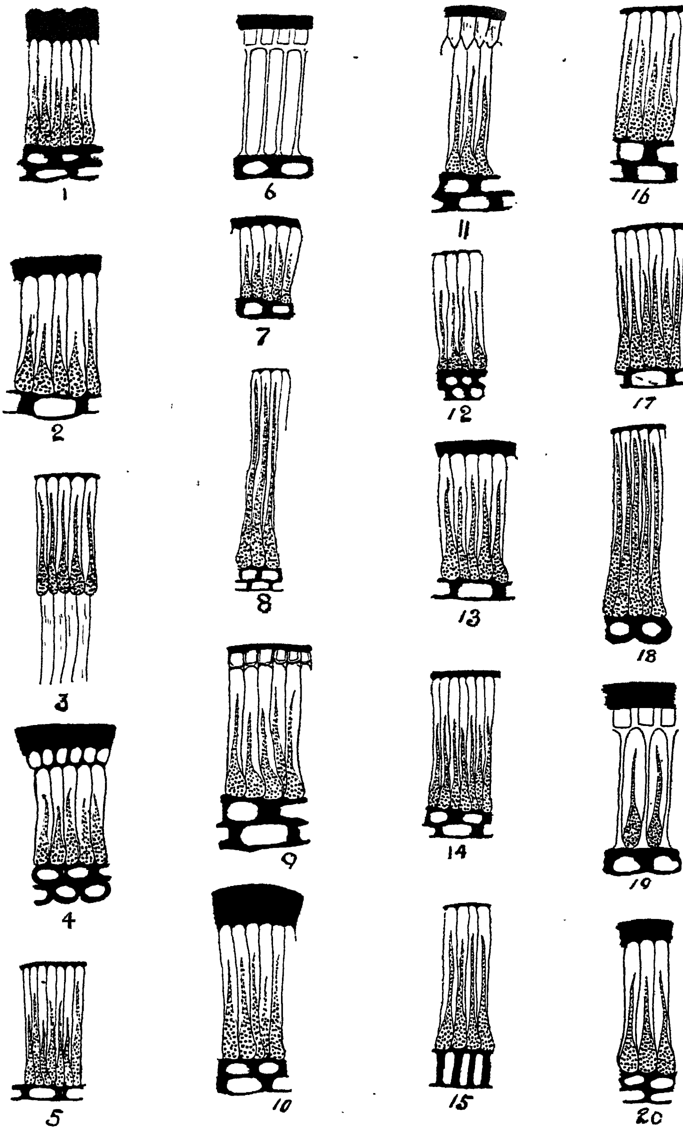
Lathyrus maritimus	.42 hours	.002 mm.
Lavatera plebeia	1.5 ,,	.026 ,,
Maba seriocarpa	.40 ,,	.006 ,,
Malva rotundifolia	.5 ,,	.004 ,,
Medicago denticulata	.42 ,,	.005 ,,
Medicago sativa	.4 ,,	.006 ,,
Mirbelia oxyloboides	.5 ,,	.013 ,,
Mucuna gigantea	8? ,,	? ,,
Oxylobium trilobatum	.42 ,,	.015 ,,
Pultenaea daphnoides	1 ,,	.006 ,,
Pultenaea retusa	1 ,,	.009 ,,
Pultenaea stipularis	1 ,,	.004 ,,
Swainsona galegifolia	1 ,,	.003 ,,
Trifolium glomeratum	.25 ,,	.009 ,,
Wistaria Maideniana	6? ,,	? ,,

EXPLANATION OF PLATES.

All are vertical sections through the epidermis and subjacent layer.

The cuticle is drawn roughly to scale, and is depicted as a deep black line forming the upper border in each drawing

1.—Abutilon oxycarpum, F. v. M.
2.—Acacia myrtifolia, Willd.
3.—Adansonia Gregorii, F. v. M.
4.—Albizzia Saman, Benth.
5.—Alhagi camelorum, Fisch.
6.—Barklya syringifolia, F. v. M.
7.—Bossiaea Stephensoni, F. v. M.
8.—Caesalpinea Bonducella, Fleming.
9.—Canavallia obtusifolia, D. C.
10.—Cassia Brewsterii, F. v. M.
11.—Ceratonia, sp.
12.—Chenopodium album, L.
13.—Crotalaria Mitchellii, Benth.
14.—Cytisus albus, Link.
15.—Daviesia parvifolia, F. v. M.
16.—Dillwynia floribunda, S. M.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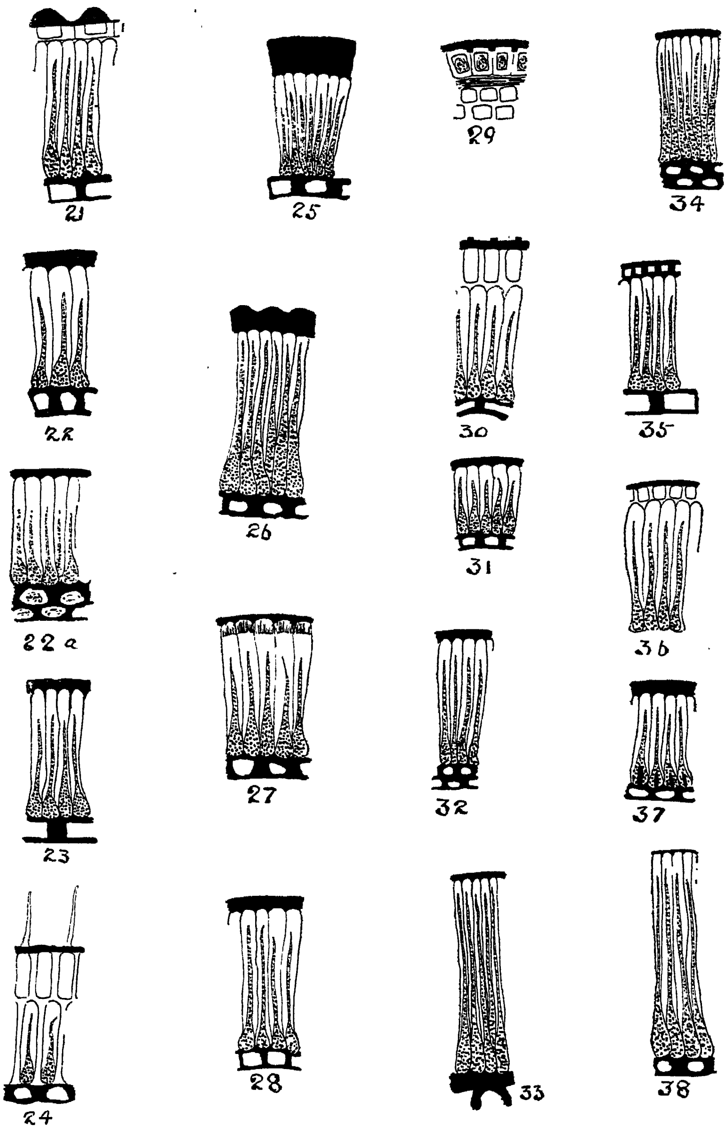
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17.—Dolichos sinensis, L.
18.—Erythrina Vespertilio, Benth.
19.—Gompholobium latifolium, S. M.
20.—Goodia lotifolia, Salisb.
21.—Hibiscus tiliaceus, L.
22.—Hovea heterophylla, A. Cunn.
22 (a).—Indigofera arrecta (Benth.?).
23.—Kennedya prostrata, R. Br.
24.—Kydia caracas, Roxb.
25.—Labichea lanceolata, Benth.
26.—Lablab purpurescens.
27.—Lathyrus maritimus, Bigel.
28.—Lavatera plebeia, Sems.
29.—Maba seriocarpa, F. v. M.
30.—Malva rotundifolia, L.
31.—Medicago sativa, Linn.
32.—Mirbelia oxyloboides, F. v. M.
33.—Mucuna gigantea, D. C.
34.—Oxylobium trilobatum, F. v. M.
35.—Pultenaea stipularis, Sm.
36.—Swainsona galegifolia, R. Br.
37.—Trifolium glomeratum, L.
38.—Wistaria Maideniana, Bailey.

In concluding this section of the paper, I wish to express my thanks to Mr. R. T. Baker, Technological Museum, Sydney; Mr. W. Guilfoyle, Botanic Gardens, Melbourne; Mr. J. H. Maiden, Botanic Gardens, Sydney; and Mr. H. C. Sampson, Trichinopoly, for kindly supplying many seeds, of which the original samples had been wholly used for germination tests.

Post Script.—The detailed account of Becquerel's work was not received until April, 1908, when the present paper was in the press. Hence it has only been possible to include the 23 positive records given by Becquerel and a few of the negative ones. The fact that Becquerel examined only 10 seeds of each kind made it possible for him to overlook any percentages below 10 per cent. The minute traces of CO_2 Becquerel found to be given off by old

air-dried germinable seeds are probably the result of surface oxidation in the integument, and hence arises the fact that exposure to light increased these gaseous exchanges instead of slightly decreasing them, as in true respiration. In addition no precautions appear to have been taken to ensure the absence of adhering micro-organisms.

Becquerel's conclusions that the impermeability of the coats of macrobiotic seeds is the gradual result of their ageing, and that only seeds with impermeable coats can last for any length of time have already been shown to be incorrect. The impermeability is due to the presence of a cuticle developed during ripening, and the presence or absence of the latter determines whether a seed will or will not have a long life in the soil, but not whether it will have a long life when preserved in dry air. Macrobiosis is the result of a biological adaptation of the protoplasm, in which an impermeable cuticle plays a merely accessory or aiding part.

In regard to the impermeability of the integuments of seeds to absolute alcohol, Becquerel has overlooked the fact that the first observation (on Cress seeds) is due to de Bary, and that this question was investigated by me with some completeness in the Trans. Liverpool Biol. Soc. 1894, pp. 207-247, in which paper an explanation is given of the fact that diluted alcohol is more fatal to dry seeds than absolute alcohol.

Hiltner and Kinzel (Zentrbl. Agr. Chem. 36, 1907, pp. 381-4) find that the hardness of the seeds of Clover and other Leguminosae increases when they are subjected to moderate dry heat, and hence they conclude that the conditions during ripening determine the percentage of hard seed. It is only to be expected that when the "hardness" is due to the presence of a cuticle, xerophilous conditions should exercise the same influence on the development of cuticle on ripening seeds as on leaves and other parts, but the partial hardening of *ripe* seeds when subjected to dry heat is probably of dissimilar origin.

In conclusion, I have to thank Messrs. Tovey and Audas, of the National Herbarium, for their zealous co-operation in the search for material, in verifying the names, and in the correction of proofs. The tedious process of seed counting was largely carried out by Messrs. O'Brien and Cronin, of the Botanical Department of the University.

[PROC. ROY. SOC. VICTORIA, 21 (N.S.), PT. I., 1908].

ART. II.—*The Silurian Rocks of the Whittlesea District.*

BY J. T. JUTSON.

WITH AN APPENDIX ON THE FOSSILS COLLECTED,

BY F. CHAPMAN, A.L.S., ETC.

(With Plates III., IV.).

[Read 12th March, 1908.]

INTRODUCTION.

The area dealt with in this paper is the whole of that comprised in the Geological Survey Quarter Sheet 3 S.E., the southerly portion of Quarter Sheet 3 N.E., and the northerly portion of Quarter Sheet 2 N.E. Whittlesea is the most central township of this district.

This block of country has the granitic rocks of Mount Disappointment in the north, and basaltic rocks in the south-west; but Silurian rocks form the major portion, and it is with them only that this paper is concerned. The contour of the Silurian area has the usual undulating appearance of Silurian country of moderate altitude in Victoria.

PREVIOUS WORK.

This appears to have been restricted to the mapping many years ago by the old Geological Survey[1]; to the determination by the late Prof. McCoy[2] of some of the fossils collected by the Survey; and to some records by Mr. Chapman from near the Yan Yean[3]. The work of the field surveyors determined the boundaries very accurately of the various geological formations; and

1 Quarter Sheets, 3 S.E. and 3 N.E., by Norman Taylor, 1857 and 1858. Quarter Sheet 2 N.E., by Robert Etheridge, Jr., 1868.

2 Prod. Pal. Vic., Decades v. and vi. and Quarter Sheet 3 N.E. List of fossils from Bb. 15, 16, 17.

3 Vic. Nat., vol. xx., 1904, p. 165.

Prof. McCoy, from the palæontological evidence, was enabled to prove the Silurian age of the older sedimentary formations, and to suggest[1] that fossils from certain localities were indicative of the base of the Upper Silurian (Silurian), a suggestion that Mr. Chapman in his Appendix to this paper, by his determination of their Melbournian age, now confirms. There was not sufficient material to indicate the geological structure of the rocks, nor to subdivide them palæontologically.

Since the work of the Survey, many more sections have been revealed by road cuttings; and these have enabled me to collect many fossils and to record observations by which the general geological structure may be ascertained, and the beds subdivided.

Lithological Characters.

The rocks throughout the area are on the whole extremely uniform in general lithological characters. They vary from thin bedded shales and mudstones of very fine grain to fairly thick bedded, coarse-grained micaceous sandstones, which are often siliceous. The finer grained rocks are generally rubbly, often conchoidal in fracture, soft under the hammer, generally contain little mica, and possess a considerable variety of colours. They are, if anything, characteristic of the Melbournian division of this area. The coarser grained rocks often contain much mica, are usually brown or yellow in colour, are frequently mottled, and possess more pronounced joints than the finer grained series. They are more indicative of the Yeringian division in this district.

The only distinctive bands are the sandstone, noted by Mr. Chapman under section V[2] in the Appendix, as containing starved forms of Camarotoechia decemplicata, Sow. sp., and a shelly limestone. The former is found forming a line of reef containing small quartz veins, on a hill to the south of Mount Phillippi. The same kind of rock (but so far as I have observed, without quartz veins), containing similar fossils, is found at Mount Phillippi, and also at section XIII. As the occurrences at the line of reef

1 Quarter Sheet, 3 N.E.

2 This and the other numbers in Roman numerals refer to the fossiliferous sections marked on the accompanying map. In the Appendix the same numbers are used to indicate the same sections.

and at section XIII. are about the same distance from the axis of the great anticline described below, it is possible that this is a distinctive band.

The limestone referred to is found at section VII. on the Cemetery Hill road. It is about 2 feet thick, and exposed along the road for about 35 feet. The rock is a tough, dense, compact, sandy limestone of dark grey colour. It is composed almost wholly of brachiopod shells, which, as usual in limestones, are only clearly seen on weathering. The fossils may be detected in abundance here, as many blocks have been cut away and removed to the side of the road, thus allowing the weather to develop the organisms. A noticeable feature is the number of a very large form of Spirifer, described by Mr. Chapman in the Appendix. A possible representative of this limestone is found at section VI., but as the arenaceous constituents of the rocks at the latter section predominate over the calcareous, the conditions of formation were somewhat different.

Geological Structure.

The map accompanying this paper (which, in its topography and geological boundaries,[1] has been compiled from the Quarter Sheets of the area) records the dips[2], copied from such Quarter Sheets, together with the additional ones taken by myself. These show that the general geological structure of the district is simple—a great anticline, and a well-defined syncline, separated by a fault.

The anticline may be traced for about 9 miles from the Yan Yean Reservoir, northward to the south-west of Mount Disappointment. Its axis runs from Barber's Creek some distance in a northern direction west of, but approximately parallel to, the railway line, the main Whittlesea road and the Plenty River. As it approaches the township of Whittlesea, it turns towards the north-west, and runs parallel to Bruce's Creek, a north-westerly tributary of the Plenty River. This coincidence of the axial line of the anticline with the direction of the Plenty River and Bruce's Creek valleys,

1 For simplicity I have ignored the Alluvial and Post-Pliocene indicated on the Quarter Sheets.

2 Indicated by double-headed arrows.

is worthy of note. As regards the cause of the deviation of the anticline itself, it may be that the granitic intrusion of the Mount Disappointment rocks is the determining factor. The average dip of the beds is about 50 deg., so that the anticline forms a broad, fairly gentle fold. This is borne out where the actual axis can be seen, as at Barber's Creek, in Quarter Sheet 2 N.E. and at the Glenburnie road, near the main road from Whittlesea to Wallan. At the latter section the anticline appears to have a slight pitch to the north. I have located only one minor fold in the main anticline. This fold—a syncline—is determined by the sections along the Cemetery Hill road. It does not appear to extend far either to the north or to the south. The beds of the anticline exposed on each side of its axis occupy, in a horizontal line, about 2 miles. The rocks are, as will be subsequently shown, of Melbournian age. From the structural and palæontological importance of this fold, I propose (following Prof. Gregory's nomenclature)[1] to distinguish it as the "Whittlesea Anticlinal."

The other main structural feature is the syncline observed near the junction of the Cemetery Hill and the Merriang roads. Its axial line crosses the former road about 100 yards to the east of the junction of the roads just mentioned[2], but such line has so far been definitely traced a very short distance. The syncline, however, is no minor fold, as the low angles maintained for about a mile on each side of the axial line demonstrate. The fold must therefore have been a broad, far-reaching one, but its septa have been removed by denudation. The strike on the eastern side of the axis averages about N. 40 deg. E., with a corresponding north-westerly dip at an angle of about 10 deg. The strike of the western side is about N. 50 deg. W. on the average, with a corresponding north-easterly dip at about the same angle as the other side. We have thus a "nosing in" to the south, with an increasing divergence of strike to the north. This "nosing in" gives rise to a series of V-shaped outcrops in ground plan. Whether this structure continues for any considerable distance, either to the north or to the south, it is at present impossible to say, on account of the paucity of dips in the former

1 The Heathcotian. Proc. Roy. Soc. Vict., vol. xv. (n.s.), pt. ii. (1902), p. 171.

2 Some apparent dips at the very small sections marked ix. on the map, would if correct, throw the axial line a little further to the east; but in view of the clearness of the road sections, these may be disregarded.

direction and the basaltic flows in the latter. The syncline pitches to the north, and the axial line can be drawn in a northerly direction for about one mile, but beyond this it is uncertain. The rocks are, as indicated later, mainly of Yeringian age, and as the syncline, therefore, is of importance structurally and palæontologically, I suggest that the name of the "Merriang Synclinal" be given to it.

There is a third possible structural feature—a fault. As already noted, the strike of the eastern side of the syncline is about N. 40 deg. E., the strata dipping at about 10 deg. The strike of the western leg of the Whittlesea anticlinal along the Cemetery Hill road is from 5 deg. to 10 deg. west of north, with a dip at an angle of about 50 deg. If the strike lines be continued to the north of the road just mentioned, they will meet at an acute angle. The only satisfactory explanation is a fault, and apparently a strike fault, so far as the Whittlesea anticlinal beds are concerned. The pitch of the Merriang Synclinal may have been caused by this fault, and the rocks of this fold would be on the downthrow side. The amount of the displacement is at present unascertainable. The probable course of the fault for about 2½ miles is indicated on the map. How far it continues cannot at present be said. Perhaps a cross fault occurs near to, but to the west of, Mount Phillippi. The section accompanying this paper indicates the general structure along the Cemetery Hill road.

FOSSILIFEROUS SECTIONS.

These, with the exception of XII. and XIII., have been dealt with, as regards the fossils, by Mr. Chapman in the Appendix.

Some of the sections are excellent, both for fossils and for structural evidence. Amongst these are III., VII., VIII. and XII. At the last named, Pleurodictyum megastomum, Dun, is the only fossil yet determined. Section III. is identical with Bb 15 on Quatrer Sheet 3 N.E. At section VII. a richly fossiliferous ferruginous sandstone occurs under the shelly limestone. Section VI. is the richest of all for fossils (trilobites and brachiopods being especially abundant); but the rocks are merely small blocks thrown out in grubbing trees. Most of the other records are either very small sections or outcrops, and where the dip is not indicated on the map, there is not sufficient

information, as a rule, to determine it. IX. represents two sections, whose fossils have become mixed, but they are both in the Yeringian area. The fossils from section X. Mr. Chapman classes as of doubtful horizon, no doubt from their scarcity and want of characteristic fossils; but the map shows that these rocks come within the Yeringian area. Section XI. has not been carefully examined, but will probably be found to be Yeringian.

Age, Extent and Thickness of the Beds.

Mr. Chapman has shown in the Appendix that the fossils collected indicate rocks of Melbournian and Yeringian age, with probable Passage beds. With this assistance, I have been enabled to indicate the areas of the respective series on the map attached. The Melbournian is practically coincident with the Whittlesea Anticlinal. There is in addition the small triangular block between the fault and the Passage beds. The rocks of this piece of country form part of the Merriang Synclinal, and are conformable to the Passage beds and the Yeringian. As they are below the Passage beds they must, for the present, be regarded as Melbournian. This will be an interesting point to settle, as if it is Melbournian, we shall then have Melbournian, Passage beds and Yeringian all conformable to one another.

The Passage beds occur at sections VI. and VII., and their field relations justify the view that the rocks at these sections form part of the same set of beds. I have therefore connected them on the map.

The area of the undoubted Yeringian rocks is small, forming part only of the Merriang Synclinal; but their northward extension will no doubt subsequently be proved.

As regards thickness, allowing an average inclination of 50 deg. for the beds in the Whittlesea Anticlinal, and assuming there is no undiscovered repetition of the beds, I estimate the thickness of the exposed Melbournian series at between 7000 feet and 8000 feet.

Taking the average angle of the known Yeringian beds at 10 deg., and with the Passage beds as a base, the thickness of the Yeringian series, as comprised within the area of the fossiliferous sections, would be about 750 feet.

The rocks along the Cemetery Hill Road between the fault and the probable Passage beds, have a thickness of about 600 feet.

Summary of Conclusions.

The Silurian rocks of the district consist structurally of a great anticlinal fold, called the Whittlesea Anticlinal, and an important synclinal fold, called the Merriang Synclinal, separated by a strike fault.

Palæontologically they can be subdivided into the Melbournian series (coincident with the Whittlesea Anticlinal) and the Yeringian series (to which part of the Merriang Synclinal belongs), such series being divided by probable Passage beds containing a rich fauna.

The estimated thickness of the Melbournian series is between 7000 feet and 8000 feet, while that of the Yeringian is about 750 feet.

A shelly limestone forming part of such Passage beds is the most striking lithological feature.

Finally, I wish to express my indebtedness to Mr. Chapman in connection with this paper. He has not only most willingly examined and determined all fossils submitted to him, but has throughout my work, aided me with his advice and encouragement.

Notes on a Collection of Silurian Fossils from the Whittlesea District, made by Mr. J. T. Jutson.

By FREDERICK CHAPMAN, A.L.S., Etc.

(National Museum).

(Plates IV., V.).

Preliminary Remarks.

The following determinations have been made upon a very representative series of fossils from both divisions of the Silurian, the Melbournian and the Yeringian; whilst there also seems to be a special fauna represented at the localities near the

Glenburnie road, and at Cemetery Hill road, which may for the present be regarded as a passage bed between the two divisions, or possibly a basement bed of the Yeringian, containing *Dalmanites meridianus* at a higher horizon than usual.

The majority of the fossils are represented either as casts in mudstone or sandstone. As is often the case, the mudstone casts afford very perfect squeezes in wax, in which all the minutiæ of a well-preserved fossil may be made out, with the additional advantage of structure produced by weathering, and not generally seen in the thoroughly mineralised fossils. Thus the vascular system of *Atrypa reticularis* is often shown with surprising clearness in the mudstone casts from the Glenburnie beds, and the same may be said of a species of *Orthis (Rhipidomella)* which occurs in the Merriang road beds, which shows both muscular and vascular impressions.

LISTS OF FOSSILS.

The numbers refer to localities so marked on map.

Melbournian Series.

I.—Yan Yean; from the tunnel to Reservoir.

Crinoids, indet. Columnars only, of a slender-stalked species; usually found in great abundance in a fine-grained sandstone.

Chonetes melbournensis, Chapm. Found both in the sandstone and mudstone. These examples are smaller than those from the South Yarra mudstone.

Nucula, sp.

Encrinurus, sp.

?Phacops.

Besides these forms I have already recorded from the same locality, *Hyolithes novellus*, Barr., and *Bellerophon*, sp., in addition to *Phacops* and *Encrinurus*, whilst the *Chonetes* was previously referred to as *Chonetes* cf. *melbournensis*[1].

II.—Corner of Kinglake and Jack's Creek Roads.

Camarotoechia decemplicata, Sow. sp.

Rhynchotrema liopleura, McCoy sp.

1 Vict. Naturalist, vol. xx., 1904, p. 165.

Rhynchonellid, indet.
?Nucula lamellata, J. Hall.

III.—Wallan Road.

Crinoids, indet. Remains of the columnars of a slender-stalked species. cf. Chonetes.
Orthis sp.
Camarotoechia decemplicata, Sow. sp. Common.
Rhynchotrema liopleura, McCoy sp. Very common.
Rhynchotrema formosa, McCoy sp. Several.
?Athyris[1]
cf. Palæoneilo or Nuculites.

IV.—Wallan Road.

Chonetes melbournensis, Chapm.
Camarotoechia decemplicata, Sow. sp.
Rhynchotrema liopleura, McCoy sp.

Probably Melbournian.

V.—From line of reef, S. of Mt. Phillippi.

Camarotoechia decemplicata, Sow. sp. A number of impressions in hard pinkish sandstone, of a starved variety. The lithological condition of this bed, and the aggregated shells, are closely matched in other occurrences of the lower division of the Victorian Silurian; whilst strata of similar character have not been observed, so far as I am aware, in the Yeringian series.

Probably Passage beds between the Melbournian and Yeringian series, but showing more of the faunal characters of the latter.

VI.—From Creek near Glenburnie Road.

?Zaphrentis, showing tendency to rejuvenescent habit of growth.

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1 This fossil may be related to those referred by Mr. R. Etheridge, Junr. (see Monthly Prog. Rep., No. 3, 1899, Geol. Surv. Vict., p. 24), to "Brachiopod allied to *Atrypa mawi*, Dav." Mr. Etheridge also records other more or less indeterminate fossils from the same district, and remarks that the fossils "are of Upper Silurian age, but whether high or low in that series, there is not sufficient evidence to determine."

?Cyathophyllum.
Pleurodictyum megastomum, Dun.
Monticulipora sp.
Crinoid columnars.
Stropheodonta alata, Chapm.
Leptaena rhomboidalis, Wilckens sp.
?Chonetes.
Orthis (Dalmanella) canaliculata, Lindström.
Orthis (Dalmanella) elegantula, Dalman.
Orthis (Dalmanella) testudinaria, Dalman.
Rhynchotrema cf. formosa, J. Hall sp.
Rhynchotrema liopleura, McCoy sp.
Rhynchotreta cuneata, Dalman.
Camarotoechia sp.
Atrypa reticularis, Linn, sp.
Spirifer perlamellosus, J. Hall, var. densilineata, nov.
Actinopteria boydi, Conrad sp.
Proetus rattei, Eth. fil. and Mitch.
Cyphaspis cf. yassensis, Eth. fil. and Mitch.
Homalonotus sp.
Phacops cf. sweeti, Eth. fil. and Mitch.
Dalmanites meridianus, Eth. fil. and Mitch.

VII.—Cemetery Hill Road Limestone Section.

Crinoid, indet.; coiled distal end of column.
Stropheodonta (Brachyprion) lilydalensis, Chapm.
Strophonella euglyphoides, Chapm.
Leptaena rhomboidalis, Wilckens sp.
Orthis (Dalmanella) testudinaria, Dalman.
Orthis (Dalmanella) elegantula, Dalman
Platystrophia biforata, Schloth. sp.
Camarotoechia decemplicata, Sow. sp.
Rhynchotreta cuneata, Dalman.
Uncinulus stricklandi, Sow. sp.
Spirifer perlamellosus, J. Hall, var. densilineata, nov.
Actinopteria boydi, Conrad, sp.
Modiomorpha sp.
A gasteropod (mould), indet.
Dalmanites meridianus, Eth. fil. and Mitch.

Yeringian Series.

VIII.—Merriang Road.

Pleurodictyum megastomum, Dun.
Crinoid remains (columnars): indet.
?Lingula.
Orthis (Dalmanella) testudinaria, Dalman.
Orthis (Dalmanella) elegantula, Dalman.
Orthis (Rhipidomella) sp.
Camarotoechia decemplicata, Sow. sp.
?Zygospira.
Atrypa reticularis, Linn. sp.
Trilobite (pygidium) indet.

IX.—Barber's Creek.

Stropheodonta alata, Chapm.
Camarotoechia decemplicata, Sow. sp.
Atrypa reticularis, Linn. sp.
?Spirifer.
?Nucleospira.
?Athyris.
Actinopteria boydi, Conrad sp.

Silurian of Doubtful Horizon.

X.—From Hill West of Glenburnie Road Beds.

Orbiculoidea sp.; probably a new form.

?Rhynchotrema liopleura, McCoy sp. Part of a ventral valve, showing strongly accentuated laminae of growth, sometimes met with in this species.

?Athyris.

XI.—From "The Gap," near Wallan.

Chonetes cf. cresswelli, Chapm. Two small examples, distinct from C. melbournensis in having numerous, comparatively strong riblets, becoming divergent near the margin.

Camarotoechia decemplicata, Sow. sp.

Palaeontological Notes.

Pleurodictyum megastomum, Dun.

P. megastomum, McCoy, 1867 (nomen nudum), Ann. Mag. Nat. Hist., ser. 3, vol. XX., p. 201, footnote.

Dun, 1898, Proc. Roy. Soc. Vict., vol. X.N.S., pt. II., p. 83, pl. III., fig. 1.

The specimens in the present collection, from Glenburnie Road and Merriang Road, afford additional evidence of the peculiar habit of this species to attach itself to the stems of crinoids, which character may also hold good for the genus. In a former paper[1] I have drawn attention to this peculiarity and in the case of the Victorian specimens, whose corallum often attains a diameter of over 5 cm., they seem invariably to select a comparatively slender-stalked crinoid for attachment, which must have imposed a heavy burden upon their host. The opportunity is now taken to correct a locality given in my paper above-mentioned (p. 107), caused by a duplication of reference letters and numbers on the Survey specimens, in which the locality B16 as there recorded should read "Simmons' Bridge Hut on the Yarra," and not "West of Mt. Disappointment"; the reference to the latter having been afterwards altered by the Survey to Bb16.

In reference to its distribution it is interesting to note that *P. megastomum* was collected by Mr. G. Sweet from near Kilmore, and probably from about the same horizon as the Glenburnie Road Beds.

Platystrophia biforata, Schlotheim, sp.

The occurrence of the above fossil in strata having a strong Yeringian facies, viz., the Cemetery Hill Road section, affords further evidence of its greater abundance in Victoria in the equivalent of the Wenlock. It has also been found in the Walhalla and Mt. Wellington Districts in Gippsland in strata which may be of similar age[2].

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1 Proc. Roy. Soc. Vict., vol. xv., n.s., pt. ii., 1903, p. 106, pl. xvi., figs. 2-5.

2 Vict. Naturalist, vol. xxiv., 1907, p. 34.

Spirifer perlamellosus, J. Hall, var. *densilineata*, nov.
(Pl. IV., Fig. 1, 2; Pl. V.).

Description.—Shell large, semicircular; extremities obtuse to acutely pointed. Ventral valve gently arcuate, beak well projected beyond the cardinal line; dorsal valve strongly convex towards the middle. Cardinal area moderately high. Median sinus wide and deep; median fold moderately wide and somewhat depressed or even concave on the top. On either side of fold and sinus, four strong, subangulate to rounded plications, and indications of two more, near the cardinal line, nearly obsolete. Shell-surface with concentric lamellæ as in the specific form, but more distinct; radial surface striæ well developed, closely arranged and almost continuous from beak to margins. Width along cardinal line in a typical example, 55 mm. Length from beak to anterior margin, approximately 35 mm.

Observations.—The present variety, *densilineata*, differs from the type form in the more distantly-spaced surface lamellæ of the shell, and the persistent striæ. The type species was described by J. Hall from the Lower Helderberg Group (shaly limestone) of the State of New York.

In a former paper, giving a list of Silurian (Yeringian) fossils from the Croydon District, I included a spirifer there referred to as *S. perlamellosus*, var. nov., and bracketed it with McCoy's *S. sulcata*. The smaller examples of the new variety *densilineata* show certain marked affinities with those figured by McCoy under Hisinger's specific name, and at the time it seemed highly probable that they made a continuous series of one variable species. A further examination of a large number of Yeringian spirifers shows, however, that McCoy was right in regarding his specimens from Yering as identical with Hisinger's species, the chief and fairly constant differences between the two forms *S. perlamellosus*, var. *densilineata*, and *S. sulcatus* being the higher delthyrium, the closer lamellation, more numerous plications, and interrupted striæ of the latter. The Croydon examples should, therefore, be referred to *Spirifer sulcatus*, Hisinger sp.

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1 Pal. N. York, vol. iii., 1859, p. 201, pl. xxvi., figs. 1, 2.
2 Vict. Naturalist, vol. xxiii., 1906, p. 239.

S. perlamellosus, var. *densilineata* was found both in the Glenburnie and Cemetery Hill Road sections, and it will probably prove to be a good zone fossil.

Actinopteria boydi, Conrad sp.

Avicula boydi, Conrad, 1842, Journ. Acad. Nat. Sci. Philad., vol. VIII., p. 237, pl. XII., fig. 4.

This species is already known from the Hamilton Group of N. America and the Upper Ludlow of Britain. It is widely distributed in our Yeringian series, having been found at Croydon and at various points in the neighbourhood of Lilydale, in addition to the present occurrence at Glenburnie Road, Cemetery Hill Road and Barber's Creek.

Modiomorpha sp.

Three examples of a modioliform shell occur on one slab from the Cemetery Hill Road section. They are bivalves having a strong umbonal ridge, concentric lamellæ, and expanded posterior cardinal area. A fairly close comparison may be made with *M. concentrica*, Conrad sp.[1] from the Hamilton Group of N. America.

Proetus rattei, Eth. fil. and Mitch.

P. rattei, Eth. fil. and Mitch., 1892, Proc. Linn. Soc., N.S.W., vol. VI., p. 316, pl. XXV., figs, 2, 2a-d.

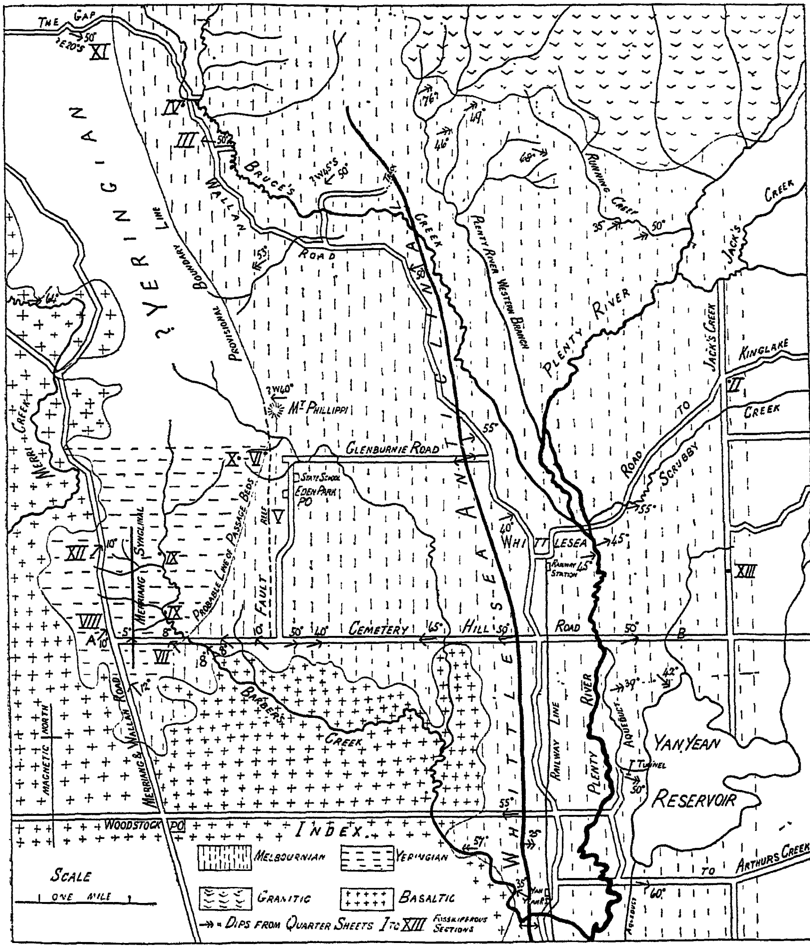
Two examples of the pygidium of the above species are found in the series of fossils from Glenburnie Road. They show the characters of the described form in the relatively long axis with eight rings and rapid contraction towards the pygidial margin. It is interesting to note the first occurrence of this trilobite in Victoria, the species having been described from the Lower Trilobite Bed of the Bowning Series, of Bowning Creek, Bowning, Co. Harden, New South Wales. The above authors ascribe the horizon doubtfully to the Wenlock.

Phacops sp., cf. *sweeti*, Eth. fil. and Mitch.

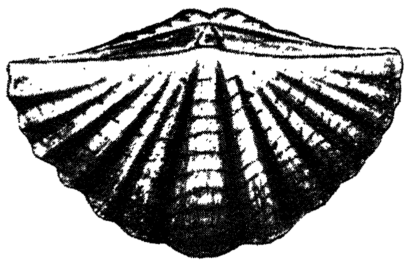
A few pygidia of a small variety of *Phacops* allied to the above species[2] occur in the Glenburnie Road material. They have a well-marked and narrow axis and a rounded pygidial border. These fossils may represent a neat variety of the

1 See Hall and Clarke, Pal. N. York, vol. v., pt. 1 (ii.), 1885, p. 275, pl. xxxvi., figs. 1-18.

2 Phacops fecundus, McCoy, non Barrande, Proc. Pal. Vict., dec. iii., 1876, p. 15, pl. xxii., figs. 8, 9, pl. xxiii., figs. 1-6.


THE GAP
? YERINGIAN
PROVISIONAL BOUNDARY LINE
BRUCE'S
WALLAN
ROAD
CREEK
PLENTY RIVER WESTERN BRANCH
RUNNING CREEK
JACK'S CREEK
PLENTY RIVER
KINGLAKE
TO
CREEK
MT PHILLIPPI
GLENBURNIE ROAD
STATE SCHOOL
EDEN PARK PO
PROBABLE LINE OF PASSAGE BEDS
FAULT
MERRIANG SYNCLINAL
MERRI CREEK
WHITTLESEA
RAILWAY STATION
ROAD
SCRUBBY
CEMETERY HILL ROAD
BARBER'S CREEK
MERRIANG & WALLAN ROAD
MAGNETIC NORTH
RAILWAY LINE
PLENTY RIVER
AQUEDUCT
TUNNEL
YAN YEAN RESERVOIR
WOODSTOCK PO
INDEX
MELBOURNIAN
YERINGIAN
GRANITIC
BASALTIC
DIPS FROM QUARTER SHEETS I TO XIII
FOSSILIFEROUS SECTIONS
SCALE
ONE MILE
YAN YEAN
TO ARTHURS CREEK
WHITTLESEA ANTICLINAL

1



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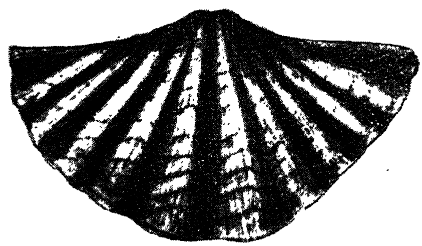

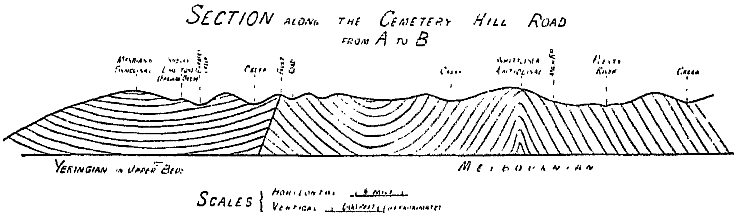
SECTION along the Cemetery Hill Road
from A to B
Yeringian in Upper Beds
Melbournian
Scales
Horizontal
Vertical

1

2

3

above species, or possibly a new form. In the absence of any knowledge of the pygidial characters of *P. mansfieldensis*, Eth. fil. and Mitch., we are unable to form any idea of its relationship to our species, but it is just possible that the two may bear some affinity. Relative to the present specimens, there is a small pygidium of a *Phacops* resembling the Glenburnie examples, from the Thomson River Limestone Beds, in the National Museum collection, which I had previously compared with *P. bulliceps*, Barrande.

Dalmanites meridianus, Eth. fil. and Mitch.

D. meridianus, Eth. fil. and Mitch., 1896, Proc. Linn. Soc. N.S. Wales, vol. X., pt. 3, p. 504, pl. XXXVIII., figs. 1-8; pl. XL., fig. 1.

Specimens of the above trilobite are numerous in the present collections from Glenburnie Road and Cemetery Hill Road. They include examples in almost every stage, varying in length from 2 to 10 cm. in the complete specimen. This trilobite was first described from Victorian specimens by McCoy, under the name of *Phacops (Odontochile) caudatus*[1], but Messrs. R. Etheridge and Mitchell have since shown it to be distinct from Brünnich's species. It has usually been obtained in Victoria from the Kilmore and Wandong Beds, which appear to contain a Melbournian facies; its persistence through at least two horizons, shown by its occurrence here in the Glenburnie Beds with a Yeringian facies is supported by its appearance in New South Wales in the Middle and Upper Trilobite Beds of the Bowning Series. *D. meridianus* is also recorded from Tasmania (Etheridge and Mitchell), and there is a typical specimen from Zeehan in the Nat. Museum collection.

EXPLANATION OF PLATE.

Spirifer perlamellosus, J. Hall, var. densilinesta, nov.

Fig. 1.—An imperfect brachial valve, showing strong lamellæ.

Fig. 2.—A nearly complete brachial valve, decorticated.

Fig 3.—External mould of a brachial valve, showing the closely packed radial striæ.

These figures are about one-fourth larger than the original specimens.

1 Prod. Pal. Vict., dec. iii., 1876, p. 18, pl. xxii., figs. 1-7; pl. xxiii., figs. 7-10.

[Proc. Roy. Soc. Victoria, 21 (N.S.), Pt. I., 1908.]

Art. III.—*The Body Spaces and so-called Excretory Organs of Ibla quadrivalvis.*

By FREDA BAGE, M.Sc.

(Biological Laboratory, Melbourne University).

(With Plate VI.).

[Read 12th March, 1908.]

Since the publication of Darwin's Monograph of the Cirripedia [2] a great deal of work has been done on these forms, which have a number of organs whose function is either unknown or disputed. The following work on the body spaces and so-called excretory organs of *Ibla quadrivalvis* has been done in the Biology School, University of Melbourne, at the instigation and under the supervision of Professor Baldwin Spencer, in order to try and clear up, for this form at least, some of these uncertain points. So far as I am aware, this species has not been worked before, and I have been fortunate in having a practically unlimited number of specimens at my disposal, as it is common near Melbourne. The investigation has been carried on by means of a series of serial sections cut transversely and longitudinally, but the toughness of the tissues renders it exceedingly difficult to secure good serial sections.

Ibla quadrivalvis grows attached to rocks in smaller or larger clusters below high-water mark. It is a pedunculated Cirripede, the peduncle being surmounted by two pairs of valves, and containing in its upper part the body of the animal.

The general body cavity is, as in all Arthropoda, a hæmocœle forming more or less irregular spaces in the loose tissue which connects the various organs of the body. In all the series, however, in addition to the hæmocœle, two definitely walled spaces attract attention at once, and it is these and their relations to other structures which are the subject of the present work.

Attached to the base of the second maxilla, and between it and the inner maxilla, on each side of the mouth, is a tubular

prominence (Plate VI., Fig. 1, t.p.) projecting at right angles to the mouth parts. In section each prominence is seen to contain a duct which serves for communication between the exterior and a large internal space. (Plate VI., Figs. 2, 3 and 5, A.) The two spaces, one on either side of the body, are most noticeable in sections, being symmetrical, and, in marked contrast to the ordinary irregular body spaces in the animal being lined throughout by a definite layer of flattened epithelium. They are situated ventral to the œsophagus, and are quite separate, only approaching one another at one place. Though Gruvel says that in *Balanus tintinnabulum* there is a connection between them at this point [Gruvel, 5], I have been quite unable to detect any in *Ibla* after careful examination of continuous series of sections of several specimens. If the spaces (A) are traced through such a series, each of them is found to open towards its own side of the body into another large cavity (Plate VI., Fig. 5, C.), the outer part of which is in contact with the body wall, and which is evidently the equivalent of the nephroperitoneal sac present in certain Decapods, e.g., Palaemon and Pandalus [Weldon, 17]. Into the large cavity (C.A.) opens on each side a space (Plate VI., Figs. 2, 3, 4 and 5, B.), lined by somewhat irregular cubical-shaped granular cells. They are apparently heaped upon the walls, and in addition form irregular partitions running across the cavity. Where this space opens into the large cavity (C.A.), these granular cells and their partitions disappear and the cavity is lined by pavement epithelial cells (Fig. 4, y.) resembling those of the portion into which the duct first opens.

We see then, that each of the organs in question consists of a glandular part (B), opening into a large saccular bladder (C. A.), which communicates with the exterior by a duct opening at the base of the second maxilla (Plate VI., Fig. 5).

The tube which opens to the exterior, is lined near to the external opening by a single layer of cells with their nuclei parallel to the length of the lumen. After some distance the character of the lining of the duct changes, the cells becoming cubic, and finally almost columnar in shape, though there is still only a single row present. The nuclei are arranged very distinctly with their greatest length at right angles to the lumen of the duct. As the tube recedes from the surface it becomes slightly wider, and in one of my series is distinctly funnel-

shaped where it opens into the definitely lined sac. The exterior cuticle is continuous over the cells lining the lumen of the tube and funnel, ending suddenly just where the cubic cells pass into the simple pavement epithelial cells lining the large sac. (Plate VI., Fig. 3, x).

The following structures are also well marked in my series of sections; and are indicated in the figures:—

1. A large gland situated between the openings of the two ducts, but having no connection with the organs in question. (Plate VI., Figs. 2, 3 and 5, g.l.)

2. Two nerve masses cut in transverse section close to space (A), but with no connection of any kind with the organs treated above. Hence the latter are not sensory in function, as Darwin [2] thought. (Plate VI., Figs. 2, 3 and 5, t.n.)

3. Definite bands of muscle on each side enter where the body of the animal is attached to the peduncle, and pass to the wall of cavity (A). (Plate VI., Figs 2, 3 and 4, l.m., o.m.)

4. On each side of the body a tubular looking structure, apparently lined by chitin, passes from the exterior to the side of the space (A). I can find no opening from it into (A), and can suggest no function for it. (Plate VI., Fig. 2, z.)

These sacs and their various accompanying parts are apparently common to all Cirripedes, and their function and significance have given rise to much discussion among all who have worked at them, many varying opinions being held.

Darwin's description for *Ibla cumingii* [2] of the orifice opening between the outer and inner maxillae and leading into a sac lined by a pulpy corium, and over part of which the outer integument is inflected, appears to me to be quite correct as far as structure goes, though his supposition as to the olfactory function of the sac is not now generally accepted. The absence of any nerve to the sac shows that it cannot be of a sensory nature.

Hoek [12] points out that Darwin's sac is not closed at the bottom, but gives entrance to the body cavity of the animal. I cannot help thinking that Darwin intended by this sac the space called body cavity by Hoek, and in that case Hoek's description agrees with that of Darwin.

In comparing my figures with those of Hoek for *Scalpellum* [12] several differences can be seen. In the first place, Hoek

figures the organ (B) as an "organ of unknown function," with no communication with cavity (A). In my preparations of *Ibla* this organ opens without doubt into the space (A). From the nature of the cells composing the walls, i.e., granular irregular cells, I conclude that the organ is glandular and probably excretory in function. Hoek also regards the group of cells lining the entrance of the body cavity into the duct, as a segmental organ, and believes it to be excretory in function. He figures this as composed of more than one layer of cells, and, though a doubt is expressed, believes this to be the case. Further, he distinctly states and shows in his figures that the cuticle does not continue over these cells, but ends further up the duct. In my sections, after careful examination, I have found no trace of more than one layer of cubical cells, and in more than one case I have distinctly seen the cuticle passing over these cells and ending, as stated above, at their junction with the flattened epithelial cells lining the cavity (A).

Gruvel [5] regards these cells as "mere annexes" to the main apparatus, and from the above description it will be seen that this is apparently the case here, as presumably no excretion could take place from them through the chitinous cuticle. They are very distinctly marked and prominent in all sections, but what their function is it is impossible to say.

Comparing these organs with structures present in other forms, there appears to be little doubt that they fall into the same category as the coxal glands of *Limulus* [Gulland, 11], the shell glands of Crustacea which open in the same position, viz., at the base of the second maxilla, and the glands of certain Decapod Crustacea [Weldon, 17].

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EXPLANATION OF PLATE.

A.—Coelomic space on each side of the body opening to the exterior by the segmental duct and lined by flattened epithelium.

B.—Space lined by granular irregular cells, which opens into space (A), and the outer part of which is in contact with the body wall.

C.—Space lined by flattened epithelium, the outer part of which is in contact with the body wall.

Labrum.	1.
Palp.	2.
Mandible.	3.
Inner or first maxilla.	4.
Outer or second maxilla.	5.
Place from which first cirrus has been removed.	6.
Body wall.	b.w.
Cubical epithelium lining lower portion of segmental duct.	c.e.
Irregular coelomic spaces.	c.s.
Irregular connective tissue filling up the spaces between the various organs of the body.	c.t.
Mouth of segmental duct.	d.u.
External cuticle covering body wall.	e.c.
Flattened epithelium lining space (A).	e.s.
Flattened epithelium lining upper part of segmental duct.	f.p.
Granular cells lining organ opening to space (A).	g.c.
Large gland situated in the outer maxillae, with no communication with the space (A), or segmental duct.	g.l.
Cuticle lining the segmental duct and continuous with that covering the body wall.	i.c.
Muscles cut longitudinally.	l.m.
Wall of mantle cavity in which body of the animal lies	m.w.
Oesophagus cut transversely.	oes.
Muscles cut obliquely.	o.m.
Pancreatic duct passing from the pancreatic gland to the alimentary canal.	p.d.
Pancreatic gland.	p.g.
Segmental duct passing from space (A) to the exterior.	s.d.
Segmental funnel.	s.f.
Supraoesophageal nerve ganglion.	sup. oes.
Muscles cut transversely.	t.m.
Nerves cut transversely.	t.n.
Tubular prominence at base of second maxilla on which the segmental duct opens.	t.p.

Male reproductive organs. t.s.

Point at which the cuticle lining the segmental duct ends. x.

Point at which the granular cells lining the organ (B) pass into the flattened epithelial cells lining (A.C.) y.

Organ of unknown function. z.

Figure 1.—Mouth parts of *Ibla quadrivalvis*, to show the position of the tubular prominences (t.p.) situated at the base of the second maxilla, and on which the segmental ducts open. From a dissection.

Figure 2.—Semidiagrammatic section through the body to show the general position and relation of the parts described in the text. The section is cut somewhat obliquely, showing on both sides the opening of the segmental duct to the exterior, and on one side the glandular organ (B), cut at the place where it is most fully shown. The muscles (l.m. and o.m.) are shown supporting the coelomic spaces (A). On one side the organ of unknown function is shown (z).

Figure 3.—Semidiagrammatic section of the coelomic spaces and parts related to them, showing the character of the epithelium lining the various parts mentioned in the text. The segmental duct is lined throughout by a single layer of cells, over the surface of which passes a continuation of the cuticle covering the external surface of the body.

Figure 4.—Semidiagrammatic section showing the glandular organ (B) opening into space (A)

Figure 5.—Diagram illustrating the parts treated in the text.

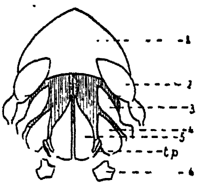


Fig 1

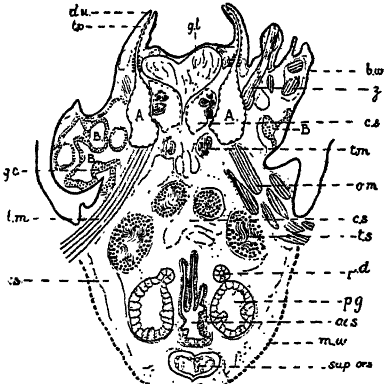


Fig 2

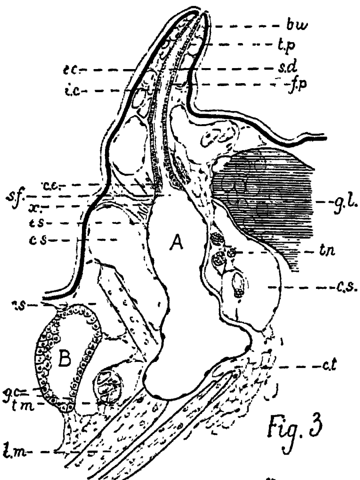


Fig. 3

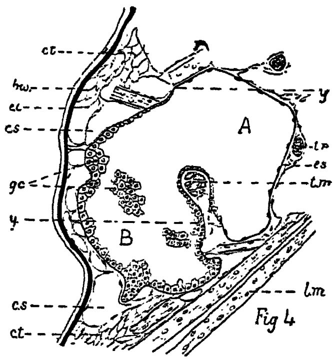


Fig 4

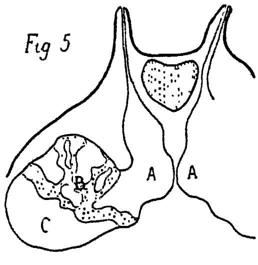


Fig 5

[Proc. Roy. Soc Victoria, 21, (N S), Pt. I, 1908]

Art IV.—*Further Descriptions of the Tertiary Polyzoa of Victoria*

Part X.

By C M. MAPLESTONE.

(With Plates VII., VIII)

[Read 9th April, 1908]

Crisia acuta, n sp. (Pl VII, Fig. 1).

Zoarium jointed, convex in front; surface glabrous, with linear punctations. Zooecia totally immersed and undefined. Thyrostomes 0 33 to 0.40 mm. apart, round; peristome slightly raised, with very acute spinous process above.

Locality, Cape Otway (J. Dennant).

A single small specimen. This species is distinguished from others by the convexity and smoothness of the front surface of the zoarium, the undefined zooecia; the linear punctation, and the very acute supra-oral process.

Idmonea elongata, n. sp. (Pl VII., Fig. 2).

Zoarium branching, 0.5 mm. broad. Zooecia in alternate series of three, 1 to 2 mm. long. Distal ends turned outwards; distance between thyrostomes in each series 1 mm., but some zooecia in the central portion are 2 mm. long.

Locality, Mitchell River (J. Dennant).

A robust species; it differs from all others in the very elongated zooecia.

Idmonea delicatissima, n sp (Pl. VII., Fig. 3).

Zoarium branching, very slender. Zooecia in alternate series of two, very narrow, 0.05 mm. wide, slightly rugose; distal ends exserted about 0.1 to 0.15 mm., exserted portion quite smooth. Thyrostomes 0.4 to 0.6 mm. apart.

Locality, Mitchell River (J. Dennant).

A very slender delicate species, with remarkably small zooecia.

Idmonea parvula, n. sp. (Pl. VII., Fig. 4).

Zoarium 2.2 mm. long, 0.8 wide, with a narrow selvedge. Zooecia in two series of three, immersed. Thyrostomes exserted, 0.3 mm. high; distance between series, 0.2 to 0.3 mm.

Locality, Mitchell River (J. Dennant).

A single specimen. The figure shows the entire zoarium, and is drawn so as to show the regular disposition of the zooecia on one side, and a lateral view of the exserted thyrostomes of the zooecia on the other side of the zoarium.

Idmonea concinna, n. sp. (Pl. VII., Fig. 5).

Zoarium short, 2 mm. long, 1.2 mm. wide, with a selvedge. Zooecia in two series of four to six; distance between the series 0.2 to 0.3 mm. Thyrostomes connate, exserted about 0.2 mm.

Locality, Filter Quarries (T. S. Hall).

This is a very short, compact form. The figure shows the complete zoarium and is drawn so as to show the regular series of connate thyrostomes on one side, and the edge shows the lateral view of the other series.

Idmonea angustata, n. sp. (Pl. VII., Fig. 6).

Zoarium narrow, branched. Zooecia 0.05 mm. wide, in two series of four to five. Thyrostomes much exserted, distance between each series 0.3 to 0.45 mm. Ooecium tumid, overlying the zooecia, situated below a bifurcation.

Locality, Filter Quarries (T. S. Hall).

This is a very distinct form, the zooecia are very narrow and very regularly disposed.

Idmonea uniseriata, n. sp. (Pl. VII., Fig. 7).

Zoarium branching. Zooecia large, in single series, 0.2 mm. wide, 1.5 mm. long. Thyrostomes 0.5 to 1 mm. apart.

Locality, Mitchell River (J. Dennant).

This species is peculiar in that there is only a single series of zooecia. It may possibly be separated generically from *Idmonea*, but the character of its growth seems to be Idmonean, though the series of zooecia are single.

Idmonea morningtoniensis, n. sp. (Pl. VII., Fig. 8.)

Zoarium ligulate, broad. Zooecia in a more or less regular series of two, three or four, diverging from the central line; distal part curved forwards; length of zooecia 0.3 to 0.4 mm.; width, 0.07 to 0.17. Thyrostome 0.05 to 0.1 mm. in diameter.

Locality, Mornington (T. S. Hall).

This species is near *I. lata*, McG., but there are fewer zooecia in each row, and they are only about half the size, and not so connate as in that species.

Filisparsa concinna, n. sp. (Pl. VII., Fig. 9).

Zoarium branching, 0.6 mm. wide. Zooecia in quincunx order, immersed, with long tubular peristomes, 0.2 to 0.4 mm. long, the immersed portion of the zooecia with a flat surface and raised margins.

Locality, Aire Coastal beds (Messrs. Hall and Pritchard).

This is a very peculiar form. I have placed it in *Filisparsa*, as the zooecia are irregularly arranged on the whole; in the central portion of the zoarium they are all in fairly regular quincunx order, but the marginal zooecia are very irregular, and the distal portion protrudes at almost a right angle to the surface, to a distance of 0.2 to 0.4 mm. The peristomes of the central zooecia are evidently imperfect. The margins of the immersed portion of the zooecia are raised, forming ridges, which is a very peculiar characteristic, and not present in any other species of the genus.

(?) **Diastopora dennanti**, n. sp. (Pl. VII., Fig. 10).

Zoarium broadly ligulate, surface nearly flat. Zooecia immersed, very slightly exserted at distal end. Thyrostomes transversely elliptical, 0.15 mm. broad, with a small lenticular cavity just inside the proximal margin. Thyrostomes 0.2 mm. apart, but the zooecia are in quincunx order, and are probably 0.5 mm. long.

Locality, Mitchell River (J. Dennant).

This is a very peculiar form, as it shows a lenticular cavity just within the proximal margin of the thyrostome, which may indicate the locality of an avicularium; though so far as I know

such an organ has not hitherto been found in a similar position in any allied form of Cyclostomata. I have placed it provisionally in *Diastopora*, but it probably, on account of the peculiar lenticular cavity, will require a new genus (if not family) for its reception. I have named this species after the late John Dennant, from whom I received the material from which it and many other new species were obtained.

Tubulipora margaritacea, n. sp. Pl. VIII., Fig. 11).

Zoarium small, ligulate, 2 mm. long; 0.8 wide. Zooecia cylindrical, partly immersed. Thyrostome tubular, exserted; surface slightly rugose, but porcellanous. Length of zooecia, 0.3 to 0.9 mm.; diameter, 0.18 to 0.15 mm.

Locality, Clifton Bank, Muddy Creek (T. S. Hall).

A single specimen, noticeable on account of the shining porcellanous surface. This genus has not hitherto been recorded from our Tertiary strata.

Tubulipora minuta, n. sp. (Pl. VIII., Fig. 12).

Zoarium small, 1.5 mm. long; 0.6 mm. wide, ligulate. Zooecia very small, immersed. Thyrostomes 0.05 in diameter, exserted 0.1 to 0.25 mm. Ooecia inflated, embracing many zooecia; surface granulated.

Locality, Mitchell River (J. Dennant).

A single specimen. Zooecia totally immersed, with the tubular orifices projecting at nearly right angles to the surface.

Reticulipora airensis, n. ap. (Pl. VIII., Fig. 13).

Zoarium reticulate; branches subtriangular in section, upper portion sublineate, showing the edges of the two zoarial laminae. Zooecia on both sides of the branches, elongated, somewhat flattened on the surface. Thyrostomes disposed in a more or less regular transverse series of five to seven. Length of zooecia 0.3 to 1 mm.; breadth, 0.1 to 0.15 mm.

Locality, Aire Coastal beds (Messrs. Hall and Pritchard).

The specimens are very fragmentary, but show that the fenestrae are more or less angular, quadrate or diamond-shaped.

This species in appearance is very similar to *Crisina* (*Retecrisina*) *obliqua*, D'Orbigny, as described and figured by Dr. Gregory in his "Catalogue of the Cretaceous Bryozoa in the

British Museum," vol. i., p. 178, pl. viii., figs. 8 and 9, but it is a very much smaller form, the zooecia are not half the width, and they are not half so numerous in the series, nor so regularly disposed. It is also similar to *R. transennata* Waters (Q.J.G.S., vol. xl., p. 689), but the zooecia are fewer in series and clearly defined, not, as in that species, totally immersed with the apertures only exserted, and there are no small tubular openings, as in *R. transennata.*

Stomatopora gippslandii, n. sp. (Pl. VIII., Fig. 14).
Zoarium adherent. Zooecia in single or double series, somewhat rugose, distal part slightly exserted; peristome elevated. Length of zooecia 0.5 to 0.7 mm.; width, 0.25 to 0.35 mm.

Locality, Mitchell River (J. Dennant).

A small fragment on the interior of a bivalve shell; it is near S. granulata (M. Edwards), but the zooecia are very much shorter.

Spiropora minuta, n. sp. (Pl. VIII., Fig. 15).
Zoarium slender, branching. Zooecia small, 0.2 to 0.4 mm. long, 0.07 to 0.1 mm. wide; distal part slightly curved outwards; regularly disposed.

Locality, Mitchell River (J. Dennant).

This is a very neat, small-celled species, and a great contrast to that next described.

Spiropora gigantea, n. sp. (Pl. VIII., Fig. 16).
Zoarium very robust, branching. Zooecia large, 0.6 to 0.9 mm. long; 0.15 to 0.25 mm. wide; distal part curved outwards. Thyrostome contracted, with an annular peristome.

Locality, Waurn Ponds (T. S. Hall).

This is a remarkably robust species, the zooecia being, comparatively speaking, enormous (the magnification of the figure is only about one-half that of the figure of *S. minuta*). At the base of three zooecia are three hemispherical processes, the function of which is problematical.

Entalophora sparsa, n. sp. (Pl. VIII., Fig 17).
Zoarium branched. Zooecia undefined, sparsely and irregularly disposed; distal portion turned outwards. Thyrostomes 0.3 to 0.8 mm. apart.

Locality, Filter Quarries (T. S. Hall).

This species occurs as long slender branches, and has very few zooecia in the whorls, which are very irregular.

Entalaphora quadrata, n. sp. (Pl VIII., Fig 18).

Zoarium robust. The whorls are composed of four zooecia in alternate series, 0 6 mm. apart, but the zooecia are 1.2 mm. long, 0.1 to 0.17 mm. wide; the front surface is flat, with raised marginal ridges; they are slightly exserted at the distal end, and the peristomes are thickened

Locality, Filter Quarries (T. S. Hall).

This species has the zooecia very much elongated, and only four in a whorl.

Entalophora airensis, n. sp. (Pl VIII., Fig. 19).

Zoarium very slender. Zooecia very long, 0.7 to 1 mm.; 0.07 to 0.15 mm. wide, in irregular order; distal portion curved outwards, with a thickened peristome.

Locality, Aire Coastal beds (Messrs. Hall and Pritchard).

This is a very slender species, the zooecia are very long, and they have a thickened peristome.

Berenicea nitida, n. sp. (Pl. VIII., Fig 20)

Zoarium adherent. Zooecia almost totally immersed; thyrostome small, 0.025 mm. in diameter, slightly exserted.

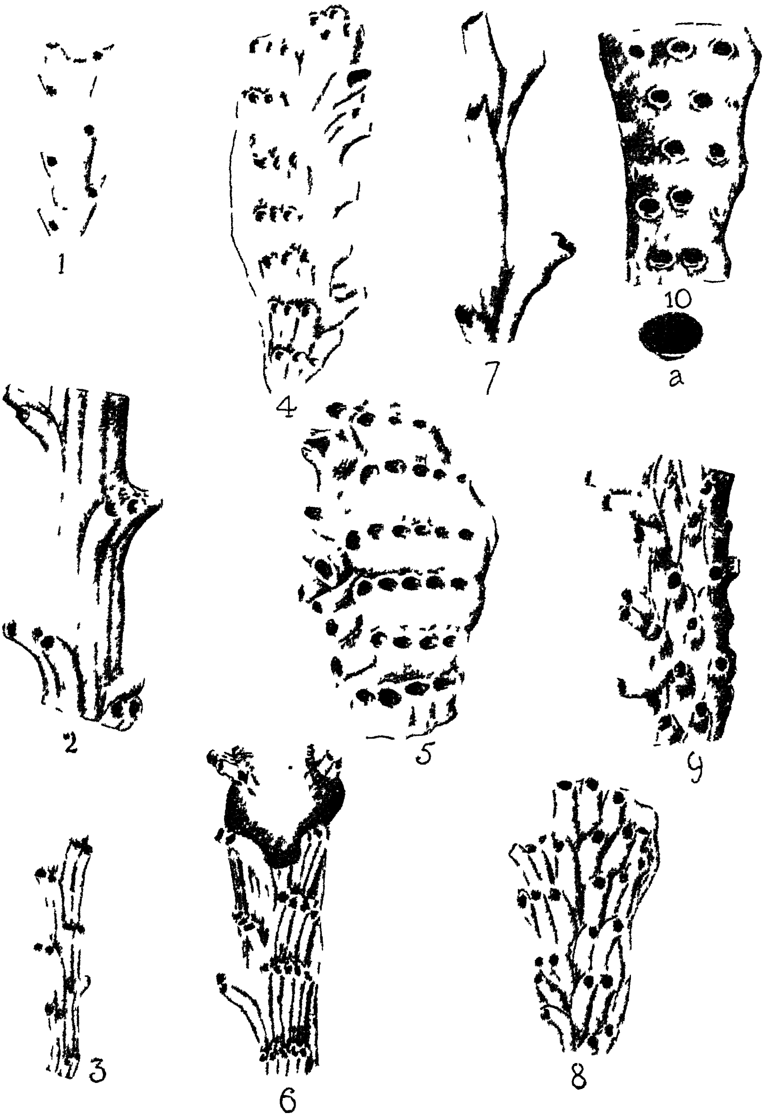
Locality, Filter Quarries (T. S. Hall).

A single specimen about 4 mm. in diameter. The zooecia are irreguarly disposed, but here and there they are in linear order, and at practically the same distance (0.1 mm.) from one another.

This genus has not hitherto been recorded as occurring in our Tertiary formations.

EXPLANATION OF PLATE.

Fig. 1.—Crisia acuta. × 48/2.
2.—Idmonea elongata. × 48/2.
3.—Idmonea delicatissima. × 48/2.
4.—Idmonea parvula. × 48/2.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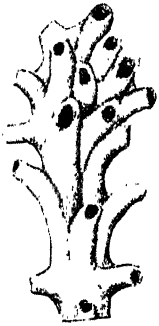

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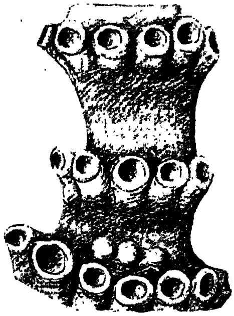

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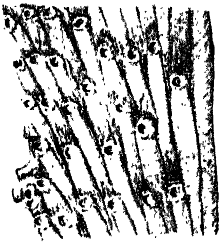

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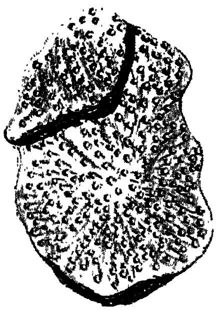

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5—Idmonea concinna × 48/2
6—Idmonea angustata × 48/2
7—Idmonea uniseriata × 48/2
8—Idmonea morningtoniensis × 48/2
9—Filisparsa concinna × 48/2
10—? Diastopora dennanti × 48/2
10a—? Diastopora dennanti Thyrostome × 100/2
11—Tubulipora margaritacea × 48/2
12—Tubulipora minuta × 48/2
13—Reticulipora airensis × 48/2
14—Stomatopora gippslandii × 48/2
15—Spiropora minuta × 48/4
16—Spiropora gigantea × 26/2
17—Entalophora sparsa × 48/2
18—Entalophora quadrata × 48/2
19—Entalophora airensis × 48/2
20—Berenicea nitida × 26/2

[Proc. Roy. Soc. Victoria, 21 (N.S.), Pt. I., 1908.]

Art. V.—*The Cherts and Diabase Rocks of Tatong.*

By H. S. SUMMERS, M.Sc.

(Geological Laboratory, Melbourne University.)

(With Plate IX.).

[Read 9th April, 1908].

In Vol. I., part 4 (1907) of the Records of the Geological Survey, Mr. A. M. Howitt briefly describes a series of cherts with associated hornblendic dyke occurring about a mile to the south-east of Tatong township. From the similarity of these rocks to the cherts of Heathcote, Mr. Howitt concludes that they probably belong to the Heathcotian series described by Professor Gregory.(1)

In December, 1905, I accompanied members of the Benalla-Tolmie Railway League from Benalla to Tolmie via Tatong and Spring Creek, and in a brief report in the "Benalla Standard" of the geological features along the proposed route, I recorded the presence of a large area of diabasic rocks near the junction of the Holland's Branch of the Broken River, and one of its tributaries, Spring Creek. Cherty rocks were found associated with the diabase, and the general lithological character of the series showed that they presented strong resemblances to the Heathcote rocks, and consequently they were recorded as being probably of Heathcotian age, that is, of pre-Ordovician age.

On further investigation, however, no sharp junction could be found between the cherty series, and the less altered sedimentary rocks with which, in Mr. Howitt's map, they are shown in contact, and one is forced to the belief that the two form only a single series in which a gradually increasing metamorphism can be noticed as the diabases are approached, the cherts representing the extreme stage of such alteration.

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1 Proc. Roy. Soc. Victoria, vol. xv. (N.S.), pt. ii. (1903), p. 148.

The Diabases.

The largest area of diabase occurs to the east and north-east of Mt. Samaria, the highest point in the district. This area is shown on the Geological Map of Victoria as belonging to the older volcanic series, but is entirely distinct from these rocks, both in structure and occurrence. The diabase runs in a north-westerly direction from a point about four miles north-west of Hat Hill, and forms a high ridge along the western side of the Holland's valley. This ridge rises to a height of 2700 ft., above sea level, and is capped in places by a conglomerate consisting mainly of pebbles of quartz and quartzite in a siliceous cement.

For some distance the Holland's Branch marks the junction between the diabase and the Devonian porphyry, but near M. Ford's allotment the river takes a fairly sharp turn to the west, and cuts across the diabase and the continuation of the ridge extends into the Parish of Toombullup, forming Bunning Hill. The upper portion of Spring Creek runs along the western boundary of the diabase, but near the junction of Spring Creek and the Holland's Branch the diabase crosses the creek valley and forms portions of the northern end of Blue Range, and extends through this ridge into the valley of Samaria Creek.

On the other side of Samaria Creek, and only separated from the main mass by alluvial flats, are a series of low hills of diabasic rocks, which occupy portions of allotments 65, 66, 70, 71, 72 and 73, Parish of Moorngag.

Further to the north, in allotments 41, 42, 43, 44 and 45, diabasic rocks form a ridge running in a north-easterly direction, the northern extension being overlain by cherty rocks.

The Cherts.

In the larger area of diabase numerous patches of metamorphic rocks are found, but these seem to be detached blocks resting on the surface of the igneous rocks, and are not definitely in situ, so that their relationship to the diabases is extremely obscure. They consist partly of chert, but are more chalcedonic than in the other areas. Jasperoid rocks and silicified diabase are also common.

At the southern end of allotment 69, Parish of Moorngag, and overlooking Samaria Creek valley, is a splendid outcrop of metamorphic rocks. These rocks are mainly grey and white cherts, in which the silicification has not been quite so intense as in other localities. The bedding is very distinct, and as the beds are exposed in an almost vertical face nearly 40 ft. high, the dip and strike are easily obtainable. The strike of the beds is N. 70 deg. W., and the dip N. 20 deg. E., at an angle varying between 35 deg. and 40 deg.

Proceeding up the hill above these beds one passes over less silicified beds until at the top of the rise micaceous sandstones and indurated shales, which are no more altered than the ordinary Ordovician and Silurian sediments found in the neighbourhood of igneous rocks, seem to overlie the cherts perfectly conformably, the strike and dip of these beds being almost identical with that seen in the cherts.

In allotment 68 we have more evidence that the cherts and sandstones form one series. Near the southern fence of this block beds of micaceous sandstones are exposed, and they are seen to be almost vertical and to strike N. 30 deg. E. Twenty-two yards to the south of the sandstones are beds of cherts which agree exactly both in strike and dip with the sandstones. About 100 yds. still further to the south, in allotment 67, more sandstones are found. These beds are also nearly vertical, and the strike is N. 25 deg. E. There seems little doubt, therefore, that at this point the cherts and sandstones are interbedded, and consequently belong to the same horizon.

On Mr. Howitt's sketch map a sharp junction is shown between the Heathcotian (?) cherts and beds marked in as of Silurian age. These so-called Silurian beds at first sight seem entirely distinct from the cherty rocks, typical specimens from the two series showing no similarity to one another. As Mr. Howitt's time was extremely limited, he had no opportunity to examine the junction, as shown on the map, and consequently sketched in an approximate boundary between the two types of sediments. When one comes to examine the rocks near the supposed junction, it is found impossible to separate the two series, as they merge gradually into one another. Passing from the fairly normal sediments, which consist of shales and sandstones, the shales being much more in evidence than the sand-

stones, we come to more indurated shales, and moving on towards the metamorphic area the shales show more and more silicification, until they ultimately pass into undoubted cherts. The sandstones do not show the same amount of alteration, but become more micaceous. It must be stated that the evidence in this area is not as satisfactory as one could wish, because the surface is covered with soil, and the nature of the underlying rock can only be judged by the fragmentary material on the surface.

About three miles north of Tatong township a triangular area of silurian rocks is shown in Mr. Howitt's map. The rocks in this area consist of sandstones, quartzite, slates, together with bands of what may be termed chertified slates. These beds are intensely indurated, but the silicification is not quite as far advanced as in the case of the typical cherts, and I think they undoubtedly represent an intermediate stage between the cherts and normal slates.

Relation of the Rocks in the Area.

In the area under consideration the following palaeozoic rocks have been recorded:—Heathcotian (?), Upper Ordovician, Silurian, Lower Devonian porphyries and Upper Devonian conglomerates, while to the south-east are the Carboniferous sandstones of Mansfield.

The age ascribed to the porphyries seems correct, as they are intrusive into the Silurian in the Broken River valley, and are overlain to the south-east by the Lower Carboniferous sandstones. Flanking the porphyries, and apparently resting on them, are beds of conglomerate, which the Survey have recorded as of Upper Devonian age. These conglomerates consist of rounded pebbles of quartzite, with occasional fragments of chert, and where the conglomerate occurs near the diabase, numerous diabasic pebbles are found. There is an entire absence of porphyry pebbles in the conglomerate, even where the conglomerate is directly in contact with the porphyry. In the bed of the Holland's, about half a mile below Dodd's Crossing, the porphyry is clearly seen intrusive into the conglomerate, so that the conglomerate beds are older than the porphyry, and therefore are probably of Silurian age. If further evidence were

required to prove their pre-Devonian age, it would be furnished by the character of the pebbles, many of which show dimples caused by intense pressure of one pebble against another during earth movements. If the beds were not in existence prior to the Devonian earth movements, it is extremely difficult to explain the dimpled nature of the pebbles, as there is no evidence of subsequent folding in this area. The conglomerate probably formed a shore-line deposit in the Silurian sea, and is part of the same series as the Silurian conglomerates near Mansfield.

The cherts were altered prior to the formation of this conglomerate, as fragments of both chert and diabase are found in the conglomerate, and, further, the conglomerate rests uncomfortably on the upturned edge of the sandstones and shales of the triangular patch already referred to, lying about three miles north of Tatong. This area is mapped as of Silurian age, but a note on Mr. Howitt's map states that the boundaries between the Silurian and Ordovician beds have not been defined. If the Silurian age of the conglomerates be accepted, these beds would seem to be not younger than Upper Ordovician, as there is a big unconformity between the two. The conglomerate is found in parts directly resting on the sandstone and chert beds. The cherts and diabase, therefore, are of pre-Silurian age, and the evidence in this area points to the age being Upper Ordovician, rather than pre-Ordovician. The evidence as to age is scanty, as no fossils of any description have been found in the Tatong area, and the nearest fossiliferous beds are some distance to the north-east.

At Edi and Myrrhee, to the east and north-east of the cherty area, graptolies have been found in the beds containing the turquoise deposits. These fossils were submitted by the Mines Department to Mr. Hall, and although they were poorly preserved, he was able to identify sufficient genera to show that they were almost certainly of Upper Ordovician age. To the north-west, at the Reef Hills, Benalla, sandstones have yielded fossils of Silurian age, and to the south-west are the Silurian sandstones and limestones of Loyola and the Mansfield area.

Mr. Howitt has recorded the strike of the Ordovician beds as being N. 40 deg. W., and that of the metamorphic rocks as N. 35 deg. W. The strike of the beds in the area north of Tatong

is N. 40 deg. W. Unfortunately these strikes are in areas fairly widely separated from one another, and so have not much significance; still they certainly show no evidence of unconformity between the Ordovician and the cherty series. In this area, therefore, the most natural position in which to place the cherts is the Upper Ordovician, what little evidence of age there is recorded being in favour of this view, and it is only comparison with the Heathcote district that makes one consider the possibility of the cherts belonging to the pre-Ordovician.

The relation of the cherts to the diabase is difficult to determine, as there is no exposure of any sharp junction between the two, the whole surface being generally covered with rich diabasic soil. Mr. Howitt recorded a hornblendic dyke traversing the cherts, so that if this dyke be connected with the diabases, the cherts must be the older series.

In general the metamorphism of the sediments seems to increase towards the contact, but exceptions to this rule may be observed.

In allotment 6, Parish of Toombullup North, is an occurrence of Selwynite similar to that obtained from Heathcote; but its relation to the other rocks is obscure, as it is surrounded by alluvial material. This is of considerable interest, as it serves as a link to connect up the Tatong area with the Heathcote area.

Petrology of the Rocks.

As I have had no opportunity yet of sectioning and examining the rocks of this district microscopically, the petrological description of the igneous and metamorphic rocks must be deferred until some future time.

Conclusions.

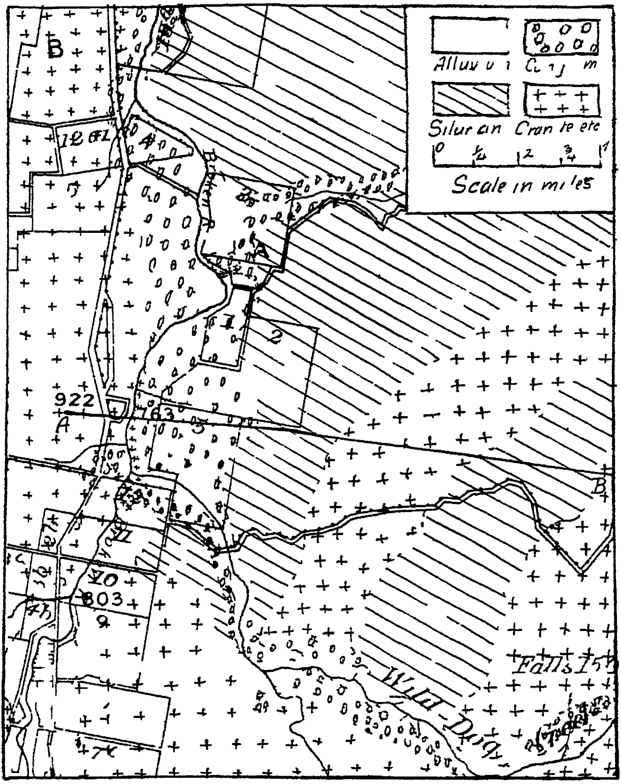
In the Tatong area the cherty series are interbedded with fairly normal sediments, and there is a gradual passage from normal sediments through all stages into cherts. This means that if the Tatong and Heathcote series are contemporaneous, then we must include in the Heathcotian, normal sediments as well as cherts and diabases. If this be accepted, then the distinctive characteristics of the Heathcotian series lose their full significance, and it becomes extremely difficult, if not impossible,

to separate them from the Ordovician and Silurian rocks unless fossils are obtained, and the question of the pre-Ordovician age of the series is called into question.

So far, however, there is no proof except the lithological character of the cherts to show that they should be considered as belonging to the same horizon. The evidence of the intrusion of the diabase into the cherts is poor, and it is possible that the various occurrences of diabases may be contemporaneous, and that the cherty rocks are post-diabase and not necessarily of the same age as one another, and consequently the cherts may be pre-Ordovician in the Heathcote area, and Upper Ordovician in the Tatong area.

EXPLANATION OF PLATE IX.

FIG. I.—Sketch Map of the Tatong District.



Silurian
Scale in miles
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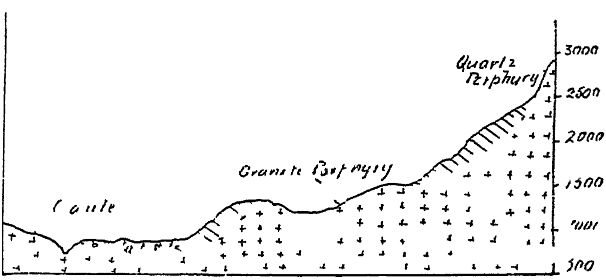
B
922
A
763
803
Falls

Fig 1



Quartz Porphyry
Granite Porphyry
3000
2500
2000
1500
500

Fig 2

[PROC. ROY. SOC VICTORIA, 21 (N.S), PT. I., 1908.]

ART. VI.—*Note on an Abnormal Development on Leaves of Prunus cerasus.*

BY BERTHA REES

(Melbourne University)

(With Plate X)

[Read 7th May, 1908].

(Communicated by Prof A J Ewart, D Sc, Ph D).

The leaves in question were found by Mr. C. French, junr., on trees grown in an orchard in South Gippsland. The form of growth was peculiar, and had the appearance of small leaflets developed on the under surface of the large leaves. (Fig. 1.) No such abnormality had been previously recorded, and consequently it was of interest to note the relative positions of the tissues in leaf and leaflet, and further to determine whether the orientation of the leaflet depended on the arrangement in the main leaf, or on light or gravity.

However, microscopic examination of serial sections (obtained by paraffin embedding) showed:—

1. That the palisade parenchyma was developed on the lower surface of the leaflet (i.e., on the side away from the larger leaf), so at first sight it appeared that the positions in the two did not correspond. (Fig. 2.)
2. That the relative positions of the phloem and xylem were also reversed in the same way as was the parenchyma. (Fig. 2.)
3. That there was no vascular bundle running down the centre of the leaflet, as might have been expected, also that the veins were continuous with those of the main leaf. (Fig. 2.)
4. That the two longitudinal halves of the apparent leaflet were connected in some instances by epidermis only, and in others by epidermis and a small amount of parenchyma. (Fig. 2.)

The above facts led me to believe that the leaflet was not an actual outgrowth, but was due to an attempt on the part of the plant to produce pinnately-lobed leaves

Pluskel has already recorded the fact that "the leaves of *Prunus cerasus* sometimes, though seldom, show pinnately divided or lobed laminae"[1]

In the present instance this view was supported by the fact that the growths appeared in between the veins, where the leaf would begin to segment, also that the different stages in the development could be traced on the various leaves Thus in Fig 1 at (*a*) the margin is only slightly split, and the edges recurved, at (*b*) and (*c*) the continuation of the margin of the leaf can be distinctly traced into the leaflet, while at (*d*) the main leaf has completely fused again above the segmentation

The explanation probably is, that during development the leaves became slightly lobed, and while the margins were still recurved a partial fusion took place at the points of contact between adjacent lobes, or in some cases a complete fusion in the laminae outside the recurved edges, as a result the edges remained free on the under surfaces of the leaves and formed apparent leaflets

Such an explanation would account not only for the position of parts and arrangement of bundles in the main leaf and appendage, but also for the incomplete nature of the connection between the two halves of the apparent leaflets.

The foregoing investigation was carried out in the Botanical Laboratory of the Melbourne University, and I desire to record my indebtedness to Professor Ewart for his interest and assistance.

EXPLANATION OF PLATE X

Fig 1—Ventral surface of leaf of *Prunus cerasus*, showing position of appendages.

Fig. 2.—Transverse section through leaf and appendage.

Reference Letters.

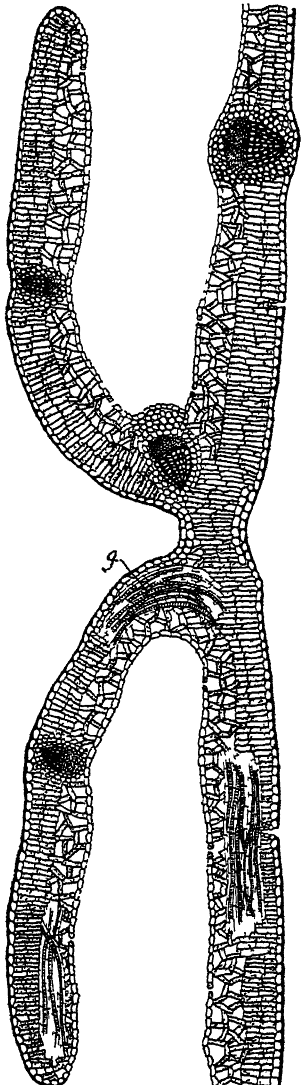
a-d.—Partially to fully-developed appendages

e.—Main leaf

f.—Appendage.

g.—Bundle turning into appendage

1. Oester Bot., Wochenbl iv, 1854 p 125



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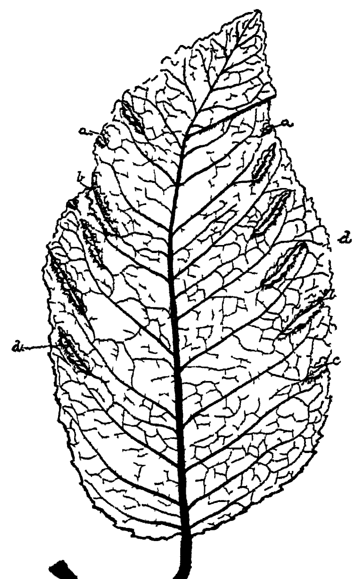

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[PROC. ROY. SOC. VICTORIA, 21 (N.S.), PT. I., 1908.]

ART. VII.—*Notes on the Dolodrook Serpentine Area and the Mt. Wellington Rhyolites, North Gippsland.*

BY E. O. THIELE, B.Sc.

(Geological Laboratory, Melbourne University.)

(With Plate XI.).

[Read 14th May, 1908].

I.—INTRODUCTION.

II.—POSITION AND ACCESS.

III.—PREVIOUS LITERATURE.

IV.—THE SERPENTINE AREA.

(*a*) PHYSIOGRAPHICAL FEATURES.

(*b*) GENERAL GEOLOGY.

V.—THE RHYOLITES AND ASSOCIATED ROCKS OF THE UPPER PALAEOZOIC SERIES.

I.—*Introduction.*

The following remarks deal with some unfinished observations made in the vicinity of Mt. Wellington, North Gippsland. They have been collected during the past four years on short vacation excursions made to this region. As the writer is leaving the State for an indefinite period, it is thought advisable to record the more important features noted, and at the same time to draw attention to problems which are still unsolved.

II.—*Position and Access.*

The district examined lies in the vicinity of Mt. Wellington, and occupies a broad belt of rough mountainous country to the north of the plains of Maffra and Heyfield.

Three routes are available for entry from the Gippsland plains, each following an important valley, namely, those of the Macallister, the Avon or the Wonnangatta rivers. No roads

exist, only indifferent pack-tracks are available, and sometimes not even these.

The Macallister route is the only one familiar to the writer, for, as it provides the readiest means of approaching Mt. Wellington, it has always been adopted. Heyfield is the nearest railway town, and thence the road is followed to Glenmaggie, about eight miles distant. These two places afford opportunities for obtaining provisions, and a supply sufficient to last till the return must be taken, for the district is almost unsettled.

Mt. Wellington can be reached with pack horses in about three days from Heyfield, and the Serpentine area in about two from the same place. The Macallister is followed as far as its junction with a tributary, the Wellington river, then the latter valley as far as the western foot of Mt. Wellington. At the Barrier Creek junction a blazed cattle track follows a long spur which leads up to the Wellington snow-plain.

III.—*Previous Literature.*

The geological literature dealing with this district is extremely scanty. More than thirty years ago Mr. R. A. F. Murray made a flying survey of this portion of Gippsland, and issued a report[1] which embodies most of our knowledge of the geology of the region. A sketch geological map was also prepared, embracing the country as far north as a line running east and west through Mt. Tamboritha. The whole of the Wellington valley, therefore, comes in in the northern portion of the sheet. Though some portions of the map require revision, it is nevertheless a most useful guide to travellers in this district. Lake Karng, at the foot of Mt. Wellington, was then unknown, and the district to the west of Mt. Wellington was not closely examined by Murray, hence he missed discovering a considerable inlier of upperordovician rocks, which are consequently not shown in his map. He, however, observed that this region would probably afford geological features of interest, for he had been informed of the occurrence of serpentine and chrome-iron ore in that locality.

The next geologist to make observations on the district was the late Dr. A. W. Howitt, who many years after Murray's ex-

1 R. A. F. Murray. Geological Sketch Map, No. 2, S.E. Gippsland; and report in Prog. Rep. Geol. Surv. Vic., No. V., p. 44.

R. A. F. Murray. Geology and Physical Geography of Victoria, 1895.

plorations, made several excursions to examine the small but interesting mountain lake, now known as Tali Karng, situated in an inaccessible mountain valley on the western flanks of Mt. Wellington. The lake was accidentally discovered in 1888 by a the lake in an account published in the Mining Department's stockman named Snowden, but the first authentic information was due to Howitt, who discussed the question of the origin of Reports, 1891.[1] The lake is due to a huge barrier, but Howitt was not able to satisfy himself as to whether the feature was to be attributed to a landslip or to a moraine. The ice origin, however, was the view most favoured.

No geological features of this district were described, but Snowy Bluff, in the Wonnangatta valley, and to the north of Wellington, was carefuly examined by both Murray and Howitt, who showed the importance and interest of the sections exposed on the slopes of this mountain. This area is better approached from the Wonnangatta side than from the Macallister valley. It was the interest attached to the origin of the lake which first attracted the present writer to the Wellington region. The first visit was made in January of 1905, and observations on the origin of the lake were published in the Victorian Naturalist of the same year.[2] The landslip origin of the lake is there upheld. During the tour, however, graptolite slates were noted on the Wellington river, and the fossils collected were reported on by Dr. T. S. Hall,[3] who showed that they represented the upper ordovician series, and the existence of a great inlier of lower palaeozoic rocks was thus established.

The serpentine and chromite mentioned by Murray were also found to occur close at hand, in the slate area. An interesting conglomerate, composed mainly of serpentine boulders in a matrix of the same kind, was found along the margin of the serpentine.

The peculiarities of this occurrence were briefly described by the writer, in a previous publication of this society.[4] The

1 Dr. A. W. Howitt. Notes on Lake Karng, Rep. Mining Department Vic., Sept. 1891 p. 28.

2 E. O. Thiele. A Trip to Lake Karng and Mt. Wellington, N. Gippsland; Victorian Naturalist, vol. xxii., 1905, p. 22.

3 T. S. Hall, M.A., D.Sc. Victorian Graptolites, part iii. From near Mt. Wellington; Proc. Roy. Soc. Victoria, n.s., vol. xviii., part i., 1905.

4 E. O. Thiele. On a Palaeozoic Serpentine Conglomerate, N. Gippsland; Proc. Roy. Soc. Victoria, n.s., vol. xviii., part i., 1905.

possibility of the glacial origin of the conglomerate was discussed, but the question was left an open one. Later observations suggest that the deposit is most likely due to ordinary aqueous agency, probably a shore line conglomerate. The scope for further enquiry, however, became evident, and opportunities to again visit the area were waited for. These were availed of two years later, when an extensive three weeks' exploration was planned into the heart of the little known region north of Wellington, including, on the return, an examination of the serpentine area. The somewhat travel-worn condition of the party on arrival at this locality after two weeks' rough travelling, together with depleted stores, somewhat lessened the opportunities relied on for working the serpentine area. A considerable quantity of material, however, was collected for chemical and petrological examination. A fossiliferous limestone was noted, containing an abundant brachiopod, identified by Mr. Chapman as *Platystrophia biforata.* The limestone was considered as representing the Yeringian division of the Silurian series. Stratigraphical evidence supporting this, however, was not available. More problems were really raised than were solved, so that in the following year a third visit was made. This time heavy rains and flooded rivers somewhat impeded observations, but as more time was available a good deal of additional information was collected. Fresh limestone outcrops were examined, and at one spot abundant but fragmentary trilobite remains were discovered. The relations of the jasperoid slates to the more normal graptolite slate was worked out, but the complete stratigraphical succession was rendered somewhat puzzling by the examination by Mr. Chapman of the trilobites from the limestone.

About the middle of last year (1907), the occurrence of massive corundum was reported from the serpentine area, and Mr. Dunn, Director of the Geological Survey, in company with Professor Skeats, of the Melbourne University, paid a flying visit to examine the occurrence, the first of its kind known in Victoria. Only a few days were available for geological observations, which were further limited by the roughness of the country. Both gentlemen, however, were impressed with the interest and complexity of the geology. An account of Mr. Dunn's observations appeared in the "Mining Standard," Oct.

16, 1907. The official report is not yet available. Last year some opportunity was afforded at the University for the chemical and petrological examination of some of the rocks and minerals collected. This was further supplemented by some valuable chemical analyses by Mr. G. Ampt, B.Sc., who formed one of the party on the 1907 trip. Mr. Ampt's analyses were conducted in the Chemical laboratory of Melbourne University This year, though time has been somewhat limited, some further petrological research has been carried out in the Geological laboratory, and considerable help has been afforded by Professor Skeats, whose personal knowledge of the district made his advice particularly valuable.

IV.—*The Serpentine Area.*

(a) Physiographical features:—

The lower palaeozoic area covers probably 40 or 50 square miles to the west of Mt. Wellington, and occupies the basin of the upper Wellington river. A large basin is here in process of formation. The crown of a great anticlinal fold of the overlying upper palaeozoic rocks has been denuded, exposing the underlying slates. These have yielded to denuding agencies more rapidly than the overlying sandstones and rhyolitic lavas, so that the slate region is marked by a great immature basin filled with lower, but still precipitous, hills, surrounded by an amphitheatre of high and imposing scarps of the upper palaeozoic rocks. The eastern wall rises particularly steeply to an elevation of over 5000ft., and is formed of a great pile of acid lavas of Mt. Wellington. The basin extends northwards to the east of Tamboritha, towards the headwaters of the Wellington, and southwards to a transverse east and west ridge joining the Avon and Macallister watersheds. The western wall is broken by the gorge through which the Wellington issues towards the Macallister.

The valleys are deeply incised into the slates, and are the characteristic narrow V-shaped mountain valleys, with very restricted alluvial flats.

Three important streams drain this basin, the upper Wellington and two tributaries. The central one is the Barrier Creek, which flows from the springs issuing at the base of the

barrier of Lake Karng. The northern portion is drained by the head waters of the Wellington, while the Dolodrook drains the southern. The valley of the last named includes a minor basin of some comparatively open, clear country, where the serpentine follows the river, and it is to this district that attention is chiefly directed.

The direction and distribution of the original streams were undoubtedly impressed upon the country before the covering of upper palaezoic rocks was removed, and was no doubt largely determined by structural features in these rocks, for the rectangular dissection which marks the drainage system of the upper palaeozoic belt can still be recognised in this area, somewhat modified, of course, by later action of the differently disposed lower palaeozoic rocks. It appears probable that this region represents a much enlarged and diverted portion of an old high-level, north-and-south strike valley, into which the lower Wellington advanced from the west, by headward erosion, and thus materially reinforced the denudation and dissection of the area. Remnants of such valleys are still preserved in other parts of the upper palaeozoic rocks at elevations of from 4000 to 5000 ft. above sea level. The soil throughout the area is generally poor, and vegetation, though abundant, is not luxuriant. On the hills the prevailing eucalypts are red and yellow box; grass is scanty, except in small patches on the ledges and saddles, generally where chocolate mudstones or basic lavas outcrop. The sandstone and rhyolite outcrops are generally rough and rocky. The snow-plains are covered in part with thick belts of stunted snow-gums, with occasional open and extended stretches, carpeted with thick snow-grass and mossy patches, from which abundant springs issue.

Thousands of cattle are annually driven up to these areas for summer grazing, and as no boundaries or lines have been fixed by the Lands Department, considerable difference of opinion frequently exists as to the rights of the various graziers who rent these rather valuable summer pastures.

On the low country the serpentine belt is in marked contrast to the surrounding slates, and is sharply delineated by the darker soil and richer grass. Unfortunately for the pastoral prospects of this district, the favoured soil area is of a very limited extent.

Undergrowth is very scanty, except along the river courses, and where bush fires have swept the hills clear of growth, the bare rubbly slate surface shows striking evidences of extremely rapid gravitation under the influence of rain storms.

(b) *General Geology of the Lower Palaeozoic Area.*

The following rocks require special attention:—

1. Serpentine and associated rocks and minerals.
2. Sediments composed largely of serpentine detritus.
3. Bluish grey crystalline and fossiliferous limestones.
4. Black jasperoid slates with network of small quartz veins.
5. Normal graptolite slates.

(1) Serpentine and Associated Rocks and Minerals.

The serpentine area consists of a narrow belt varying in width from about a quarter of a mile to about two chains, and extending a little over three miles in length. The most northerly outcrop is to be seen in the bed of the Dolodrook river, at the mouth of Black-Soil Gully. Here the outcrop is about two chains wide, and lies between black jasperoid slate on the north-east side, and black slate with bluish calcareous bands on the south-west. The strike of the slate is the normal one throughout the area, being approximately north-west. The dip is at a high angle, and apparently to the north-east, but the rocks are contorted, and satisfactory observations could not be obtained. The serpentine is much decomposed here, and it is not clear whether it represents the original rock in situ, or compacted serpentine detritus, such as is found elsewhere interbedded in the lower palaeozoic sediments.

Travelling in a south-easterly direction up Black-Soil Gully to its head, no more serpentine is seen till the head of the gully is reached, for the underlying rocks are concealed beneath a considerable thickness of black soil, full of black slate fragments, but largely derived from the serpentine rocks higher up. The only rock outcrop noted was where the detritus had been washed out of the bed of the gully, exposing the jasperoid slates. These rocks outcrop also on either side of the valley. The serpentine is again exposed in the saddle at the head of the gully, known as the Monument Gap, and it can be traced thence

continuously south-east for about three miles. It descends to the Dolodrook river, which it crosses just above its junction with Thiele's Creek. This stream has been so named by local bushmen, and its name perpetuated by Mr. Dunn. Beyond this junction the serpentine continues on the south side of the Dolodrook for a distance of about one mile, widening out to form a patch of open, park-like country, about a quarter of a mile in width, and well covered with good kangaroo grass. Returning to the Monument end, a number of features of interest present themselves. The serpentine in general is much crushed and foliated, and the general strike of the foliation planes is north-west, in conformity with the strike of the slates. Evidence of some shearing and considerable crushing is to be seen throughout the rocks.

The schistose edges of the outcropping rocks are prominent in some parts, and project here and there in a characteristic knife-like manner. A small pinnacle about 12 ft. high is known as the Monument, and from its vicinity a grand and imposing view is obtained eastwards to the precipitous cliffs and table top of Wellington, and westwards down the deep valley of the Wellington river to the rock-ledged summit of the "Crinoline." Last December (1907) the view was rendered particularly striking and charming by a heavy fall of snow, which brought out an infiinite number of rock structures as the snow lay in the crevices and depressions on the mountains.

Several types of serpentine are to be found, partly due to different stages in the alteration of the original igneous rock, and also to the character of this rock. A dark green to black, even-grained serpentine with a tendency to a slight mottled character, is fairly common. Microscopic sections show that the original rock was rich in olivine, and probably a peridotite. A further stage in oxidation shows a greener base with numerous red spots, forming rather an attractive rock when polished. Such a rock occurs in Roan-Horse Gully. An analysis of the dark variety, by Mr. Ampt, is given:—

Serpentine, Dolodrook Area.

Silica	38.43
Alumina	3.08
Ferric oxide	.37

Ferrous oxide - -	6.40
Magnesia - - -	35.08
Soda - - - -	.77
Potash - - -	.37
Water combined - -	13.58
Water hygroscopic -	1.35
Chromic oxide - -	.16
Manganese - - -	.12
Copper oxide - -	.06
Nickel oxide - -	.38
	100.15

Density - 2.80

Numerous boulders lie scattered about on the grassy slopes of the serpentine belt; some are waterworn, and evidently have weathered out of a serpentine conglomerate, to be referred to later. Other blocks, however, are irregular, and appear to represent portions of the original basic rock of the serpentine. Considerable variety is exhibited by these rocks. Most of them are tough pyroxene rocks, showing varying stages of alteration. One type common in the vicinity of the Monument Gap is a coarse-grained rock, extremely tough, and composed largely of a green, rhombic pyroxene, corresponding most closely to bronzite. About a third of the rock, however, consists of a hard, white mineral generally somewhat opaque. It is perhaps a secondary felspar, and parts of freshest sections show traces of the repeated twinning of the original triclinic felspar.

An analysis of this rock by Mr. Ampt is given:—

Silica - - - -	51.87
Alumina - - -	5.28
Ferric oxide - - -	2.29
Ferrous oxide - -	7.37
Lime - - - -	8.71
Magnesia - - -	22.52
Soda - - - -	.47
Potash - - -	.31
Water combined - -	.97
Water hygroscopic -	.17
Chromic oxide - -	.21
Manganese - - -	.10

Nickel - - -	.21
Copper - - -	.06
Titanium diox. - -	tr.
Phosphoric anhyd. -	tr.
	100.54

Density - 3.222

Another type varies from a creamish white through violet-grey to a light-green, coarse-grained rock. This rock consists almost entirely of monoclinic pyroxene, partly diallage, and some interstitial talcose mineral and serpentine. It is difficult to determine the limits of these rocks, and often, also, to decide whether the rock is in situ or not.

A spur descending from a point near the top of the Kangaroo Spur southwards to the Dolodrook River to a point above the junction of Thiele's Creek, shows a number of outcrops of the monoclinic pyroxene rocks, which are most probably in situ. Thin sections of these rocks frequently show considerable granulation and deformation of the constituents, indicating the intensity of the pressure to which the rocks have been subjected. Occasional foreign fragments have been noted in the slides, and have been no doubt picked up by the magma.

An analysis of a creamish-white rock, representing a somewhat altered type of the monoclinic pyroxene rocks, with some interstitial talcose mineral, is also due to Mr. Ampt.

Silica - - - -	36.36
Alumina - - -	18.54
Ferric oxide - - -	4.18
Ferrous oxide - -	1.15
Lime - - - -	23.44
Magnesia - - -	8.29
Soda - - - -	.68
Potash - - -	.25
Water combined - -	5.97
Water hygroscopic -	.82
Titanium dioxide - -	.62
Phosphoric anhyd. -	tr.
Chromic oxide - -	tr.
	100.30

Density - 3.237

One feature worthy of note can be observed in several places, notably a few chains west of the corundum outcrop on Kangaroo Spur, and again in a small gully to the west of the chromite occurrence, and that is the character of the dark greenish-black peridotite serpentine. At both these spots the appearance suggests an agglomerate, but more investigation is required to decide whether this is the case or whether the features are simply due to a particular type of weathering, simulating the fragmental character of an agglomerate.

Special Minerals.

The following require particular attention:—

(1) Corundum.
(2) Chromite.
(3) Common Opal.

(1) Corundum.—This was first found about the middle of last year by two bushmen, Macfarlane and Piden. Specimens were sent to the Mines Department, and also to the writer. The occurrence at once attracted the attention of Mr. Dunn, Director of Geological Survey, hence the flying visit by Mr. Dunn and Professor Skeats.

The corundum was found to occur sporadically in lumps up to about 3 cwt. in size, at two spots not far distant, namely, the Monument Gap and a little to the east, on the Kangaroo Spur, as indicated on the map. The mineral is violet in colour, somewhat translucent, compact and massive, rather tough, and breaking with a somewhat splintery fracture. A certain amount of a green amorphous mineral is present in small quantity, as impurity. This is probably a hydrated silicate of alumina, coloured with oxide of chromium.

Thin sections show the corundum as irregular patches of a violet colour, with numerous long prisms of the same mineral, forming a somewhat mesh-like appearance. Pleochroism is distinct. A small amount of interstitial material shows low polarization colours, and as the analysis shows very little magnesia it is probably some form of hydrated silicate of alumina.

A massive corundum has since been found in the Heathcote area by Professor Skeats, and a slide of this shows somewhat

similar characters, with the exception that the interstitial mineral shows higher polarization colours. Both slides suggest that the corundum is original, and not secondary.

Through the courtesy of Mr. Dunn I am able to give an analysis of a sample of the Wellington Corundum, made in the Mines Department Laboratory.

SiO_2	3.90
Al_2O_3	85.11
Fe_2O_3	0.42
FeO	0.41
MgO	0.15
CaO	0.46
Na_2O	0.26
K_2O	0.23
H_2O + above 110	7.03
H_2O − below 110	0.07
CO_2	nil
TiO_2	1.05
P_2O_5	nil
Cr_2O_3	1.40
MnO	nil
CrO	nil
SO_3	nil
Cl	nil
	100.07

Density - 3.580

An analysis by the writer of a somewhat purer sample containing less of the green mineral was, unfortunately, not completed.

It indicated less than 0.5 per cent. SiO_2, nearly 90 per cent. Al_2O_3, and only a trace of CaO and MgO.

(2) Chromite has long been known to exist in this area, but on account of the inaccessibility of the district, little exploratory work has been done. A few shallow holes have been sunk, exposing a few lenticular blocks up to several hundredweight in size.

Both microscopic and chemical investigation of the serpentine shows the presence of the mineral in small amount throughout the area. The following analysis was made by Mr. Ampt.

SiO_2 - - - -	6.60
Al_2O_3 - - - -	16.34
Fe_2O_3 - - - -	5.20
FeO - - - -	8.62
CaO - - - -	0.24
MgO - - - -	17.15
Water combined - -	1.22
Water hygroscopic -	0.37
CoO - - - -	0.12
MaO - - - -	tr.
TiO_2 - - - -	tr.
P_2O_5 - - - -	tr.
Cr_2O_3 - - - -	45.03
	100.89

Density - 3.881

The question of the genesis of the corundum and the chromite can be conveniently discussed together, for the association in the Dolodrook district suggests analogies to similar occurrences elsewhere. In North America, corundum is known both in acid and in basic rocks. The latter occurrence is worthy of comparison. In North Carolina it is found near the margin of peridotite rocks, in which chromite also occurs, and J. H. Pratt, who has studied the occurrence, considers that the origin is best referred to as one of magmatic segregation. Morozewicz further showed experimentally that alumina is soluble in a molten, basic glass, and that on cooling the alumina rich magma crystals of corundum crystallized out.

No excavations have been made in the Dolodrook area to determine whether the corundum is in situ or not, but there is little reason to suspect that it is not, and Professor Skeats tells me that he has found it and chromite distributed in small quantities through the rocks of the Heathcote area, in which he has found the larger pieces of corundum. Chromite is recognised both as a secondary and an original constituent of igneous rocks, but it would appear the Dolodrook occurrence most probably indicates a particularly fine example of magmatic segregation, in which the olivine, pyroxenes, corundum and chromite all represent different phases.

The common opal is present only in small quantity, and of no particular interest. It is clearly secondary. The age of the serpentine will be referred to later.

(2) Sediments Composed Largely of Serpentine Detritus.

These deposits vary from coarse or waterworn conglomerates to fine-grained, hard banded rocks.

The conglomerate has been referred to in a previous paper. It can be examined at two outcrops, namely, at the Monument Gap and in the bed of the Dolodrook River, above Thiele's Creek junction.

In both places it lies along the south-western margin of the serpentine belt. At the Monument Gap, both the boulders and the matrix consist almost entirely of serpentine. Mechanical deformation and differential movement have squeezed and striated the boulders, but the evidence of aqueous origin appears to be still fairly pronounced.

In the bed of the Dolodrook, however, some finer beds are associated, containing some rounded and sub-angular fragments of a compact black rock suggesting at first sight black slate, but microscopic evidence shows this rock is a fine-grained, igneous one, and the matrix consists of serpentine and numerous fragments of pyroxene.

These beds dip westerly at a high angle, and overlie the coarser conglomerate which flanks the serpentine. A little further west, lower down the Dolodrook, the black graptolite slates form a bluff. The relation to the detrital serpentine rocks is not clear, but they appear to overlie them, which is in conformity with observations in other parts. In Roan-Horse Gully, east of the chromite occurrence, the fragmental beds are again exposed, and here portions show considerable calcification, some portions being of the nature of ophicalcite. An analysis of this material was made by Mr. Ampt.

Carbonate of Lime -	44.09
Silica - - - -	24.70
Alumina - - -	4.22
Ferric oxide - - -	.75
Ferrous oxide - -	5.36
Lime - - - -	3.99

Magnesia - - -	11.75
Soda - - - -	.22
Potash - - -	.20
Water combined - -	3.54
Water hygroscopic -	.53
Chromic oxide - -	.23
Manganese - - -	.07
Nickel - - -	.19
Copper - - -	.05
Strontia - - -	.03
Titanium dioxide - -	.19
	100.11

Density - 2.827

Close to Garvey's Hut, on the opposite side of the Dolodrook, fine-grained fragmental rocks, composed of igneous minerals, occur, They are stratified, but weather into long slender boulders, showing a marked spheroidal weathering. Here again microscopic evidence shows that they are composed of fragments of pyroxene and serpentine, but it is not clear whether they are sub-aqueous tuffs or normal sediments. These beds overlie the trilobite limestone a short distance down the stream, and are so closely associated with graptolite slates that it appears impossible to separate them.

(3) The Limestones.

These rocks occur as a number of small lenticular outcrops along a line conforming in general to the strike of the ordovician rocks, and a short distance away from the serpentine belt, on its south-western side. The most southerly outcrop is south of the chromite occurrence, close to Roan-Horse Gully. Here, as is the general case in this district, the rock is a hard bluish-grey crystalline limestone. A brachiopod identified by Mr. Chapman as *Platystrophia biforata*, is abundant in this outcrop, and as this fossil is known to Mr. Chapman in other Victorian limestones, which he regards as Yeringian (Silurian), he considered this limestone to belong also to this series.

Since this decision, however, trilobites have been found at the other end of the limestone belt, and these fossils open up very

interesting questions with regard to the age of the limestone. The specimens identified show such an extremely remarkable association of genera that better preserved material is urgently required before safe conclusions can be drawn. At present, however, it can be stated that on stratigraphical evidence one would be strongly inclined to group the limestone with the Upper Ordovician slates.

(4) The Jasperoid Slates.

These rocks are well exposed in several places, notably on the Dolodrook River, below Garvey's Hut, as shown on the map, and again on a spur to the south of the same hut.

Until last January the age of these rocks had not been fixed, and as it seemed to be a growing custom to consider all black jasperoid and cherty rocks in the Lower Palaeozoic areas of Victoria as Heathcotian, it was advisable to test the case in the Dolodrook area.

Careful search in this district showed clearly that here these rocks must be grouped with the normal black slates of Upper Ordovician age, for the characteristic graptolites were found throughout the series, and highly silicified bands were found clearly interbedded with the normal slates.

Thin sections of various grades of the indurated slates showed fine examples of various stages in the silicification. All showed evidence of extreme pressure developing a schistose structure marked by undulating lines, too black and dense to be determined, but containing a minute micaceous mineral. Abundant lenticles of secondary quartz and chalcedony make up the greater part of the rock.

(6) The Graptolite Slates.

There is now really no need to separate these from the jasperoid slates. They are all one series, exhibiting different degrees of induration and silicification. They form the prevailing rock surrounding the serpentine belt, and afford graptolites in numerous localities. These fossils have been described in a paper by Dr. T. S. Hall. Many outcrops show intense contortion and crumpling, so that observations of dips are generally

not of much use. Thin sections failed to show what was the nature of the original rocks from which they were derived.

(7) The Succession of the Rocks.

This cannot be said to be established yet, but considerable evidence has been collected since Mr. Dunn's hurried visit. This observer admitted that his ideas were only tentative. Two features largely influenced Mr. Dunn's reasoning:—

(1) The consideration of the limestone as Upper Silurian on Mr. Chapman's identification of the *Platystrophia*. The trilobite had not then been found.

(2) The interpretation of the black fragments in the conglomerate as black slate, and probably, therefore, indicating a post-Ordovician deposit.

An older age for the limestone now seems more reasonable, and the argument of the black fragments does not hold, since they are not slate, but fragments of a black igneous rock, as shown by thin sections. Mr. Dunn regarded the Ordovician as the oldest rock, the serpentine, or rather the original pyroxene rocks, as intrusive into the Ordovician slates, while the fragmental serpentinous rocks and limestones were grouped as Upper Silurian. The succession, however, which appears more correct to the writer, would place the massive serpentine and allied rocks as the oldest series—at least pre-Upper Ordovician; next, perhaps, the fragmental serpentine conglomerates, etc., limestones and slates. Further fossil evidence is necessary to determine whether further sub-division is necessary, but at present the course most in conformity with stratigraphical evidence is to consider the whole of the post-massive-serpentine series as Upper Ordovician.

V.—*The Rhyolites and Associated Rocks of the Upper Palaeozoic Series.*

As the writer has no time at present to do justice to the information collected on these rocks, they will be included simply to render available some analyses which were made last year in the University laboratory. The lavas include both acid and

basic ones, the former largely predominating. They show an infinite variety of texture and colour, but chemically all are closely similar.

The commoner varieties show a base varying in colour from light green to pink and dark chocolate-brown. Phenocrysts consist of quartz and orthoclase felspar, the latter varying from white to pink.

One type from the western slopes of Wellington, in the vicinity of Lake Karng, is an attractive rock with a light greenish base and moderate sized phenocrysts, of white orthoclase and quartz. Thin sections show a fine perlitic structure.

In general from a structural point of view two divisions can be made:—

(1) Those showing marked flow structure.

(2) Those of the type of normal quartz porphyries.

Thin sections of the latter often show the phenocrysts embayed by the devitrified magma, but occasionally sections show no such features, and sharp, angular fragments of quartz and felspar form a granular base, suggesting a pyroclastic origin, but this feature is hard to establish. These rocks are of great extent and thickness, and their relation and distribution has been briefly referred to in a former paper.

	Banded Rhyolite, southern plateau of Wellington	Quartz porphyry, southern shore of Lake Karng. Dark greenish base, with phenocrysts of pink orthoclase.
SiO_2	78.64	78.47
Al_2O_3	9.85	10.68
TiO_2	0.67	0.59
Fe_2O_3	0.54	0.18
FeO	2.00	2.23
MgO	0.10	tr.
CaO	0.80	0.66
Na_2O	2.03	3.29
K_2O	5.16	4.15
P_2O_5	tr.	tr.
Water combined	0.40	0.2
Water hygroscopic	0.14	0.09
	100.33	100.54

The Basalts (Melaphyres of Howitt) belong to the upper palaeozoic series, and are frequently much altered. They frequently contain geodes and amygdales of chalcedony. Epidote and calcite are abundant as alterations products.

	Moroka Snow-plain—fairly fresh sample. By Mr. Ampt.	Bad Spur, Moroka Valley—rather altered specimen.
SiO_2	49.35	43.88
Al_2O_3	17.61	16.58
Fe_2O_3	1.50	5.53
FeO	9.72	9.11
CaO	7.71	9.60
MgO	3.17	5.77
Na_2O	3.10	2.02
K_2O	1.56	1.06
P_2O_5	tr.	tr.
Water combined	2.56	2.22
Water hygroscopic	0.65	0.64
TiO_2	2.83	3.52
MnO	0.07	tr.
Pyrite FeS_2	0.34	
	100.17	99.93
Density	2.918	

In conclusion, I desire to express my indebtedness to Professor Skeats, Dr. T. S. Hall, Mr. F. Chapman, F.L.S., Mr. H. J. Grayson, Mr. G. Ampt, B.Sc., and Mr. E. J. Dunn for help in collecting information on this area. At the same time I must offer apologies for the fragmental character and numerous shortcomings of this paper, due to extremely hurried compilation from notes, and to its being written under rather unfavourable conditions on the steamer between Melbourne and Adelaide.

APPENDIX.

Preliminary Notes on a Collection of Trilobite Remains from the Dolodrook River, N. Gippsland.

By FREDERICK CHAPMAN, A.L.S., &c.

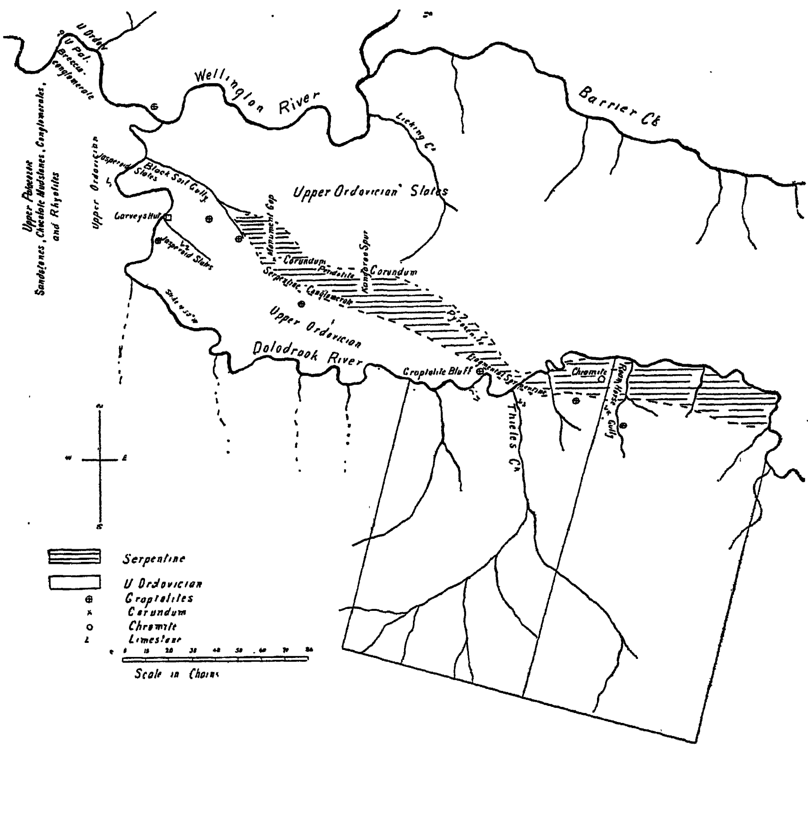
(National Museum.)

The following notes are based on some fragmentary fossils, all trilobitic, which Mr. E. O. Thiele, B.Sc., late of the Victorian Geological Survey, and now on the staff of the Imperial Institute, London, discovered in a bed of dark bluish limestone associated with Upper Ordovician slates at the Dolodrook River, Mt. Wellington District, N. Gippsland. Mr. Thiele has kindly placed the material in my hands for description, and, although the fossils are far from perfect, it seems advisable to publish the following brief notes upon them, with a view to affording some information as to the age of this limestone, which comes from a district of which the geology is still far from being fully known.

The limestone in which the fossils are found is hard and subcrystalline, and the method of its fracture does not entirely favour the extraction of the fossils. Moreover, the trilobites themselves have become disjointed, especially in the thoracic region, in most cases before being covered with sediment, since no examples of the pleura were seen, except the merest fragments.

The generic forms present belong to *Agnostus* and *?Proetus*, whilst a doubtful type, perhaps referable to *Cheirurus*, is represented by two imperfect tail-shields.

Agnostus sp. nov. Of this form both head and tail-shields are present. It is a member of the group Longifrontes, the distinguishing characters of the prominent glabella and the impressed line separating the anterior part of the cheeks and the lateral lobes of the tail behind the axis, being well marked. In general


Wellington River
Barrier Ck
Upper Ordovician Slates
Upper Ordovician
Dolodrook River
Thiele's Ck
Serpentine
U Ordovician
Graptolites
Corundum
Chromite
Limestone
Scale in Chains

form it compares most nearly with *A. pisiformis*, L. sp., and *A. punctuosus*, Angelin. The affinities of the Australian species seem to lie rather with the Cambrian than the Ordovician forms.

?*Proetus* sp. nov. Remains of a large and handsome form, with a wide and straight anterior border, long glabella and granulose cheeks, are common in the limestone. The specimens show very marked characters which tend to separate them from species of the genus sensu, stricto, and their nearest allies seem to be certain Proetids from the Girvan area in Scotland, of Upper Ordovician age, and younger.

?*Cheirurus*. The remains of two pygidia show them to have a depressed, but roundly terminated axis, which does not extend to the posterior margin, few segments, and a wide lateral border; whilst at the posterior angles were stout spines. Vestiges of other detached spinous processes also occur in the matrix.

But for the presence of the new species of *Agnostus*, it might be assumed that the limestone was of Upper Ordovician age, taking into consideration the facts of the association of the beds. The presence of this older form, however, makes it an open question as to the contemporaneity of the limestone and the adjoining slates. It is to be hoped that better and more copious material will be forthcoming from this very interesting district, when these and other forms can be fully described, and inferences drawn with more certain knowledge.

PLATE XI.

Sketch Map of the Dolodrook Serpentine Area.

[Proc. Roy. Soc. Victoria, 21 (N.S.), Pt. I., 1908.]

Art. VIII.—*The Graptolite Beds at Daylesford.*

By T. S. HART, M.A., F.G.S.

(With Plate XII.).

[Read 11th June, 1908].

During the last few years, on several visits to Daylesford I have collected fossils at a large number of localities. Many of these have kindly been examined and identified by Dr. T. S. Hall, and the horizon of the beds determined. The greater part of the collecting has been done between Sailor's Creek, on the west, and the line of the Dry Diggings Road, on the east, extending north and south over a distance of about six miles, with Daylesford in the centre. The following notes are a summary of the information obtained at about sixty fossil localities.

Previous References.

A geological survey of about 140 square miles in the vicinity of Daylesford was commenced by Krause, and a progress report dated Oct. 1, 1877, is contained in Progress Report No. 5 of the Geological Survey of Victoria. He states that it is apparent from the persistent westerly dip between the Loddon and Daylesford, that the uppermost beds are exposed on or in proximity to the meridional ridge, of which Wombat Hill forms a conspicuous point; that thence westward the beds are much folded and fractured, and with these beds the principal auriferous quartz reefs are associated; that graptolites are abundant in these "upper" beds; and that the general strike of the beds near Wombat Hill is 16 to 22 degrees west of north, but that further north it becomes more meridional. The only fossils mentioned are Graptolites fruticosus and Phyllograptus folium, which are stated to be the most common species.

The survey was subsequently continued by the late Norman Taylor, whose report is contained in Progress Report No. 8 of the

Geological Survey. He states that he has not noticed the persistent westerly dip between the Loddon and Daylesford, referred to by Krause. He mentions several fossil localities, four of which are marked on his map, but gives no further names except Hymenocaris. His map is published as quarter-sheet 16 N.E.

The area to the south, of which the map is quarter-sheet 16 S.E., was surveyed by Mr. S. B. Hunter. The report is in Progress Report No. 9 of the Geological Survey. He mentions the occurrence of graptolites, and states that both east and west of the most folded belt there is a persistent dip to the west.

Dr. T. S. Hall, in his paper on the Geology of Castlemaine (Proc. Royal Society of Victoria, Vol. VII., new series, 1895) refers the only Daylesford fossils which he had then seen to the zone of Tetragraptus fruticosus. Referring to this in a paper dealing with other features of these rocks (Proc. Royal Society of Victoria, Vol. XIV., pt. 2, n.s.), I mention them as the lowest parts of the Castlemaine series, meaning thereby the lowest parts of the rocks which occur at Castlemaine, not the Castlemaine series in the more limited sense in which that term is now commonly used.

More recently Dr. Hall has identified other fossils from this district (Records Geological Survey of Victoria, Vol. I., pt. 4, 1906, and Vol. II., pt. 1, 1907), of which the localities and horizons are as follows:—

Cornish line of reef (stated by Mr. E. J. Dunn to be from the mullock heap at the Victoria Cornish Engine Shaft, and probably from the 966ft. level), at the top of the Bendigo series.

The Springs, Daylesford, Bendigo horizon.

Bullarto, Castlemaine horizon.

From the Daylesford Gold Mine Tip, probably Bendigonian, and others from the same locality, Wattle Gully Beds. Mr. W. Baragwanath, jr., who collected these, considers that they were both probably from material excavated in sinking from 400 to 500ft.

From a shaft quarter mile south of the Cornish Co.'s new shaft, Castlemaine series.

From the north side of the Jubilee Lake, quarter mile east of the railway, Upper part of the Castlemaine series. Mr. Barag-

wanath informs me that these were from material from a tunnel. From his information, also, I make a slight verbal correction in the last two localities.

Mr. E. J. Dunn refers the beds mainly to the Castlemaine zone, but in part to the Bendigo zone. This is apparently largely by the weathering colours (Records Geological Survey of Victoria, Vol. II., pt. I., p. 10).

General Outline of the Following New Observations.

I have divided the area into three. My western localities are from about the line of the strike passing through the Ajax Mine, westward. All my fossils from these localities are referable to the Bendigo series, but the localities are widely scattered, and the field relations of the beds to one another are seldom ascertained.

Central Belt.—In this the rocks are often well exposed and much folded. Most of my observations are in this area. Bendigo beds occur on its west side, and probably recur on anticlines further east, associated with the Wattle Gully series, but no higher beds have been demonstrated.

Eastern Localities.—These are scattered localities east of the Ballarat Railway, near Woodburn, and eastward from the Springs at Hepburn, and one far east locality. In these also the field relations of the beds are not observed. All the fossils are referable to parts of the Castlemaine Series above the Wattle Gully Beds.

I have numbered my fossil localities in order for facility of reference, and described their positions in terms which allow of their being readily located. The fossils identified by Dr. Hall and his statements as to horizon I have marked thus: †. The remainder of the names, confined almost entirely to common forms, are from my own notes.

Details of the Fossil Localities.

Western Localities.

In the Deep Creek at Eganstown black pyritic slates occur, but no fossils were obtained.

1.—On the Ballarat Road, west of the turn of the road at which small dykes are marked on Hunter's map, and near the top of Sailor's Hill, in a small cutting on the south side of the road. Tetragraptus fruticosus, Didymograptus bifidus, and Phyllograptus typus.

2.—In the cutting at the west end of the Sailor's Creek embankment, Ballarat Road. Strike north 10 degrees west, dip easterly at 73 degrees, near an anticline. The same three species with small crustacea.

The horizon of these will be high in the Bendigo Series.

3.—On the east side of Sailor's Creek, on the low point opposite the Tipperary Spring. This is the spring marked on Taylor's map a short distance upstream from Tipperary Point. Phyllograptus typus,†, Tetragraptus bryonoides,†, T. pendens,†, Goniograptus thureaui, variety with five branches,†, and another Goniograptus,†, Didymograptus cf. nicholsoni,†, Rhinopterocaris.

Strike north 20 degrees west, dip easterly. A syncline is close by to the east, but the easterly dip is quickly resumed. An anticline occurs a short distance to the west.

4.—East bank of Sailor's Creek opposite Taylor's note 30. Tetragraptus fruticosus,†, T. quadribrachiatus,†, Bendigonian,†, Rhinopterocaris maccoyi and smaller crustacea are also present.

5.—Close to 4. Tetragraptus pendens,†, T. bryonoides,†, Goniograptus thureaui,†,. Dr. Hall refers it doubtfully to the upper part of the Bendigonian. I have also T. fruticosus and Phyllograptus typus. The bed is probably identical with 4, and quite close to 3, so that all these three localities may be referred to the Bendigonian.

6.—Taylor's note 24. Dip westerly. Tetragraptus fruticosus,†, T. serra,†, T. bryonoides,†, T. quadribrachiatus?,†, Phyllograptus typus,†, Goniograptus macer,†, Typical Bendigonian,†, Crustacea are very common, some of which Mr. F. Chapman has identified as Caryocaris cf. angustata.

7, 8.—At the present Ajax shaft, and at an old shaft close by, Tetragraptus fruticosus. This is at the site of Taylor's note 31.

9.—At a shallow shaft between the Ajax and Nuggetty Ajax shafts, T. fruticosus with Phyllograptus typus. These three localities were all in loose blocks from the shafts.

10.—On the right bank of Wombat Creek, near the west boundary of the borough. T. fruticosus is probably present. This seems to be probably the locality referred to above as the Springs, Daylesford.

11.—In east dipping beds east of the south-east corner of the Stony Creek Basin, and west of allotments 28, 29 ; in a race cut in the bedrock in an area of sluiced ground. Tetragraptus fruticosus,†, T. serra, Phyllograptus typus,†, Goniograptus sp. Rhinopterocaris maccoyi, and smaller crustacea. Bendigonian,†.

An anticline passes a short distance to the west of this locality, and is perhaps the same as that which passes west of the Ajax shaft.

12.—From a shaft near Stony Creek Falls, in poorly preserved material, Phyllograptus typus.

13.—In the bed of Sailor's Creek, about west of the last mentioned locality a few fossils were found, but nothing recognisable.

The localities from which the above fossils were collected are too few and widely separated to give a safe idea of the whole of the beds present. They are in the Bendigo series, and the more western localities, 1 to 5, high in that series. They do not require any great thickness of beds, and do not suggest a persistent westerly dip. I know of no records of newer fossils to the west. A slight prevalence of westerly dips is possible.

The Central Area.

Besides being more accessible, this area affords numerous natural sections, road cuttings, sluiced areas, shafts, tunnels, and other workings.

A nearly continuous section may be obtained from 11 down a gully to Wombat Creek, and a little further to the north up the Smith's Creek valley.

About 75 paces to the east from 11, measured across the direction of the strike, a roll occurs in the strata, but the easterly dip is at once resumed, and continues to a syncline near the north-west corner of allotment 27.

14.—In the bed of the gully, and west of the syncline, Didymograptus bifidus,†, a few Phyllograptus typus,†, Tetragraptus bryonoides,†, T. serra,†, T. quadribrachiatus,†.

15.—East of the syncline, perhaps the same bed, Didymograptus bifidus,†, D. extensus,†, Rhinopterocaris maccoyi,†.

Both these are Wattle Gully Beds,†.

Thence to the mouth of the gully the dips are westerly, though in some places difficult to observe in the thick, highly cleaved slates. The anticline must occur just outside this gully, and can be seen a short distance to the north, in an excavation on the east side of the Ballan-road, at the south end of the embankment over Wombat Flat. The anticline has a well-marked pitch to the south, and some thin quartz veins seem to follow round the beds and outcrop in curved lines on the floor of the excavation.

16.—At the south end of this cutting, and immediately east of the anticline, Phyllograptus typus is the most abundant, and Tetragraptus fruticosus is doubtfully present. Didymograptus bifidus was not noticed.

In the bed of the creek to the east the syncline is just exposed, and shows black slates from which it was difficult to obtain any fossils.

17.—A little to the south, in the bed of the creek, a very few fossils were obtained, comprising Didymograptus bifidus, Phyllograptus typus, and probably Tetragraptus serra. The horizon is therefore uncertain. It may be uppermost Bendigonian or Wattle Gully Beds.

Continuing to the east up Smith's Creek, an anticline and a syncline closely following are seen a little east of the Lake Road. Both these have a strong southerly pitch. Thence westerly dips continue to an anticline which passes under the hill on which the Victorian Cornish south shaft is situated. This anticline is easily traceable up the south side of the valley, and passes immediately east of the South Cornish Company's shaft. Continuing to the south it crosses the railway at the footbridge, but is not actually seen, as an old valley filled with basalt occupies the position where it would appear. The change of dip is clearly seen on the two sides of this valley, the whole width of which is exposed in the cutting.

18.—In the mouth of a small tunnel on the north bank of Smith's Creek, and a little east of the anticline. In my notes I have that Phyllograptus typus is most abundant with doubtful Tetragraptus fruticosus, but none of the material sent to Dr. Hall was determinable.

19.—From loose material here, Phyllograptus typus,†, Tetragraptus bryonoides,†, either Castlemainian or Bendigonian,†.

20.—South Cornish Company's mullock heap, T. fruticosus,†, Bendigonian.

This anticline, like the previous one, has a southerly pitch.

21.—West of the last mentioned anticline, in a gully north of Smith's Creek and independent of it. North-west of the south shaft of the Victorian Cornish Co., Tetragraptus fruticosus, Phyllograptus typus, Rhinopterocaris and small crustacea.

22.—East of the anticline last mentioned, north-east of 18 and high up on the north side of Smith's Creek, in east dipping beds. A trench had been cut along the next bed with the fossil bed on its wall, so that large quantities of material were available. Tetragraptus bryonoides,†, Didymograptus cf. nicholsoni,†, Clonograptus flexilis?,†, Clonograptus spp,†, Phyllograptus typus†, age uncertain, probably Bendigonian,†. I noticed no examples of either Tetragraptus fruticosus, Didymograptus bifidus or D. caduceus.

23.—A few fossils were noticed in slightly newer beds a short distance down the hill from 22.

It appears, therefore, that Bendigo Beds do reach the surface on this anticline. I was formerly under the impression that they did not, as my first Bendigonian fossils in this vicinity were all from mine mullock heaps.

24.—A loose block containing Tetragraptus fruticosus was found on the Lake road, near the long tunnel. Its origin is quite uncertain, owing to the great length of this tunnel, but in in view of the southerly pitch of the anticline near the last localities, Bendigo beds would scarcely be expected on the surface near this tunnel on it, and there is no sign as yet detected of their appearance further east. There is, of course, the possibility that the tunnel workings have at their entrance re-handled shaft material, or that the block may have not come from the tunnel at all.

Higher up Smith's Creek the dip is for some distance easterly from the localities 18 and 22. A syncline with an anticline quickly following on the east, appears, and further east the bedrock is buried under basalt.

East of the South Cornish shaft, an anticline is exposed both in

the road and railway cuttings. Where it would be expected in Smith's Creek I found no break in the easterly dips. The strike of locality 22 would pass close to or east of this anticline. The anticline is broadly curved.

25.—East of this anticline in the road cutting east of the railway. Didymograptus bifidus,†. Phyllograptus typus,†, Tetragraptus serra,†, T. bryonoides,†, T. quadribrachiatus,†, Clonograptus or Dendrograptus sp,†, Castlemainian, Wattle Gully Beds,†.

From the locality 11 to the head of the exposed Ordovician in Smith's Creek is a distance at right angles to the strike of about three-quarters of a mile. From the syncline between 14 and 15 to the anticline at 19, there is a preponderance of westerly dips to the extent of about 1200 feet, and some of the short stretches of easterly dip have a comparatively flat dip for some part of their length. There may be in all 1000 feet in thickness of beds exposed, the lowest of which are Bendigonian and the highest Wattle Gully.

Between 11 and 14 there is not room for the whole of this series to be repeated in the distance of about eight or nine chains, yet the beds at 11 appear to be at least as old as those at 19. Similarly between the South Cornish shaft and the anticline at the railway crossing there is only a distance of about three or four chains, yet beds appear which are of the Wattle Gully series and probably not far removed in age from the beds at 14 and 15.

The most probable explanation seems to be that there is unobserved faulting at both these places, with an upward movement on the west side, so that some beds are cut out of the surface section. As these would probably be reversed faults, their direction would be similar to those on which the Cornish and the Ajax reefs are situated.

If such faults recur at other parts of the district, they would counteract a preponderance of westerly dips, as they actually do in this section, and would therefore tend to reconcile the statements of Hunter and Krause as to prevalent dips, with the evidence of the fossils.

An attempt was made to trace the folds of the Smith's Creek section in the railway cuttings and other exposures to the south.

The anticline and syncline at the lower end of Smith's Creek appear to converge to the north and spread apart to the south. On the north bank of the Lake two anticlines are probably present corresponding to those at 19, and perhaps 25. An anticline occurs at the Woodburn siding, exposed in a drain near the road crossing. A syncline occurs at the north end of the big bank to the south, and the big cutting beyond shows an anticline and syncline. Fossils were obtained at several places.

26, 27.—In the two cuttings between the Lake and Woodburn. Only Tetragraptus serra from one of these, and Phyllograptus typus from the other, were recognised.

28.—At one of the mullock heaps of the Rising Star (now Victorian Star) mine. Phyllograptus typus and Tetragraptus fruticosus. The shaft is 750 feet deep, and they are probably from the lowest workings.

29.—In the bed of the Creek above the big embankment south of Woodburn, a few fossils were noticed, but were indecisive as to the horizon of the beds.

30, 31, 32.—Three localities in the big cutting. At all of these Didymograptus bifidus† is by far the most abundant fossil. In addition there are Tetragraptus bryonoides† and Phyllograptus typus† at 30 and 32, and T. quadribrachiatus† at 32.

30.—At the north end of the cutting east of the anticline.

31.—Beyond the anticline, but before the syncline.

32.—Near the south end of the cutting, west of the syncline.

These are all near the same horizon, and the same bed may be repeated. All are Wattle Gully Beds.

This anticline seems to be most probably the same as passes west of 11. No Bendigo Beds are exposed in the cutting, but their disappearance is in accordance with the consistent southerly pitch seen on the anticlines and synclines as before mentioned. If the identification of the anticline is correct, one anticline and one syncline seem to disappear southward from the series before described.

33.—A few fossils were obtained in Wombat Creek, a little above the Lake Road Bridge. Their horizon was uncertain, but the beds are probably the same as at 17.

34.—In Kidd's Gully east of the Daylesford Co.'s shaft, one small Didymograptus caduceus.

35.—Lower down Kidd's Gully, north-east of the same shaft. Tetragraptus fruticosus is doubtfully present.

36.—A short distance upstream from the junction of Whitefield Gully and Kidd's Gully. A few fossils were obtained, among which Didymograptus bifidus was most common.

37.—In Spring Creek, at the mouth of Wild Cat Gully, Phyllograptus typus was observed.

38.—Road cutting on the Hepburn Road west of Doctor's Creek. Phyllograptus typus,†, Tetragraptus bryonoides,†, and sponge spicules,†, Horizon uncertain,†.

A good series of sections are exposed from the locality 6 downstream to the junction of Spring Creek and thence up Spring Creek and Woman's Gully.

An anticline with a strong northerly pitch occurs a short distance east of 6, followed by a syncline with a similar pitch, and another anticline. This syncline and anticline cross the creek twice in the bend south-west of the Hepburn recreation ground, and also cross Spring Creek just above its junction with Sailor's Creek.

39.—Close to the syncline west of the recreation ground. Didymograptus bifidus.

40.—On the west bank of the Creek, and west of the syncline, and north-west of the recreation ground. T. fruticosus,†, Bendigonian,†.

41.—On the west side of Sailor's Creek and opposite the mouth of Spring Creek. Tetragraptus fruticosus,†, T. bryonoides,†, Phyllograptus typus,†, Didymograptus bifidus?,†, Clonograptus abnormis,†, Bendigonian uppermost zone,†, Rhinopterocaris maccoyi and other crustacea are also present. Immediately to the south there is considerable mixing of these slates with the sandstones, giving something of the appearance of a conglomerate.

As the pitch is northerly and the beds are near a syncline and some distance north from the locality 6, they would be expected to be somewhat newer, as is also indicated by the fossils.

After the syncline and anticline already referred to as crossing Spring Creek there is for some distance up that creek an easterly dip. A syncline occurs before reaching the road, and an anticline immediately east of the road embankment at Breakneck.

42.—Road cutting south of Spring Creek at Breakneck, west of the anticline. Didymograptus bifidus,†, D. caduceus one small,†, Tetragraptus bryonoides,†, Phyllograptus typus most abundant,†, sponge spicules,†, Wattle Gully Beds,†.

43.—In bed of creek east of the same anticline. Didymograptus bifidus,†, most abundant, D. extensus,†, Tetragraptus bryonoides,†, Wattle Gully Beds.†

These two localities are in beds close to one another, and as easterly dip have been in excess from the last fossil locality, we would expect higher beds, as is indicated by the fossils.

A syncline soon follows, and an anticline after some distance, which should bring up slightly older beds than 42, 43, but no fossils were obtained to show whether the Bendigo beds reach the surface again. Four more anticlines were located further east, but no more fossils were found.

On the whole the northern localities show a succession of folds with Wattle Gully Beds east of the localities of Bendigo fossils, and a slight prominence of an anticline corresponding in character to the anticline at the Cornish mine.

At two or three places in this central area somewhat coarser sandstones than usual were noticed at a position which was probably near the dividing line between the Bendigo and Wattle Gully beds, but the evidence was not sufficient to regard them as being restricted to this part of the series.

The Eastern Localities.

44.—Bed of Wombat Creek, quarter mile east of the head of the Lake. Didymograptus caduceus, some large.

45.—At a shallow shaft a short distance to the south from this. D. caduceus,†, large. Castlemainian,? middle,†.

These are further east than Baragwanath's locality.

46, 47, 48.—Three localities in Argyle Gully. D. caduceus was found at two of them, and Phyllograptus typus at the middle one, near an anticline.

49.—On the ridge north of Argyle Gully, and east of Spring Creek. Didymograptus caduceus,† and Phyllograptus angustifolius,†.. Typical Castlemaine series,†.

50.—On the ridge between Wild Cat and Woman's Gully, about 50 chains east of Spring Creek. Didymograptus caduceus,†,

very abundant, Phyllograptus angustifolius,†, and Dichograptus octobrachiatus?,†.

51.—On the same ridge and about 25 chains to the north-east. Didymograptus caduceus large,†.

52.—East side of a cutting on the Dry Diggings road, south of Dry Diggings. D. caduceus,†.

53.—Mullock heap of a shaft near Beehive Reef Dry Diggings. D. caduceus,†, D. nitidus,†, and Phyllograptus angustifolius,†.

54.—Taylor's note 91. D. caduceus,†, D. nitidus,†, and Tetragraptus quadribrachiatus,†.

49 to 54 Dr. Hall refers to the typical Castlemaine series, and 51 probably highest. 51 is about the position at which Krause placed the highest beds. I have no information with regard to these localities, as to their relation to one another, and whether they are the higher or lower beds in their immediate vicinity. Between 52 and 54 there is a belt about a mile and a-half in width, from which I have no fossils. I do not think it likely that the trough of a main syncline lies at 51, as there is no reappearance yet detected of the Wattle Gully and Bendigo Beds to the East.

The principal gold workings in quartz are within the central strip or on its margin. This is within the limits which Dr. Hall regarded as gold-bearing at Castlemaine. There is little gold working to the east, where higher beds of the Castlemaine series probably occur. Though the western area has not much important mining at present, it is to some extent gold-bearing, and may correspond to one of the less productive zones which occur even in the Bendigo central area.

The prevalent southerly pitch at the south end, and prevalent northerly pitch at the north end bring in newer beds across the strike of the Cornish anticline, and cause these beds also to encroach on the area of Bendigo beds further to the west.

SUMMARY.

In the above notes I have referred the various beds to horizons in accordance with Dr. Hall's subdivision of the series of beds at Castlemaine. In view, however, of the differences in the fossil succession, as described by him from that noticed in other

countries, a review of the observations, independently of any such subdivision, seems desirable.

Having regard to the prominence of the various fossil species, as observed in collecting, the following characteristics of different beds are noticed:—1. There is a series of beds in which *Didymograptus caduceus* is abundant and sometimes large, often the only fossil collected. With it are *Phyllograptus angustifolius* and *Didymograptus nitidus*, neither of which I found in other beds, and *Tetragraptus quadribrachiatus*, which also occurs in other beds.

2nd. There is a series of beds characterised by the extreme abundance of *Didymograptus bifidus*, with which *Phyllograptus typus* is often common, *T. bryonoides* and *T. quadribrachiatus* being the most frequent other fossils in these beds.

3rd. In the remaining localities (excluding those from which the observations are too meagre to be safe), *Phyllograptus typus* is usually common, and practically always present. Other most frequent fossils are *Tetragraptus fruticosus* and *T. bryonoides*. *D. bifidus* is seldom present, and never common in these beds, and *T. fruticosus* was never observed in beds in which D. bifidus is common.

4th. At one locality, 22, with *P. typus* and *T. bryonoides*, *Clonograptus* was conspicuous, but neither *T. fruticosus* nor *D. bifidus*, nor *D. caduceus* was noticed here.

As regards the relations of these beds:—That locality in which *Clonograptus* is conspicuous is clearly just above beds containing *T. fruticosus*.

The *bifidus*-beds at 14 and 15 lie close to a syncline. Beds with *fruticosus* appear near the anticlines, on both sides of them, at 11 and 16.

The *bifidus*-beds at 30, 31, 32 lie near an anticline and syncline. Whichever of the anticlines this is, it is one on which *T. fruticosus* appears further north, and the pitch is southerly.

The *bifidus*-beds at 25 would appear, apart from possible faulting, to be near the horizon of the surface beds at the South Cornish shaft. From the workings of this shaft *T. fruticosus* was obtained, and further north on the anticline which passes close to the shaft, the same fossil also occurs in beds exposed at a much lower level in the gullies. The pitch of this anticline is considerable, and southerly.

The *bifidus*-beds at 42 and 43 are east of the *fruticosus* beds at 41, with some excess of easterly dips intervening.

In every case, then, where the relations of the *bifidus* and *fruticosus* beds are observed, the *bifidus* beds are the newer.

The field relations of the *caduceus* beds were not so well observed, but the following points seem important:—

D. caduceus was never conspicuous in the localities in which *D. bifidus* is abundant, and was never noticed present with *T. fruticosus.* Easterly dips prevail east of the anticline at 18 to the head of Smith's Creek. Anticlines and synclines near here have a distinct and consistent southerly pitch. The *caduceus* localities 44 and 45, and Mr. Baragwanath's locality lie to the south-east from here.

No repetition of the *fruticosus* beds occurs between the eastern localities with *caduceus*, and the furthest east localities with abundant *bifidus*.

No repetition of the *caduceus* beds occurs to the far west in any of the localities examined.

The *caduceus* beds without *typus* certainly cannot be placed between the *bifidus* and *fruticosus* beds, in both of which *typus* is abundant, and the field evidence is too complete also to suppose they had been overlooked in this position. They must either be below the *fruticosus* beds or above the *bifidus* beds. All the field evidence favours the higher position.

Of the three groups of beds the order then is:—

3rd. Beds with abundant *D. caduceus*, newer than

2nd Beds with abundant *D. bifidus* and with *P. typus*, newer than

1st Beds with *T. fruticosus* and *P. typus.* Oldest here observed.

This is in agreement with the determinations at Castlemaine already referred to, but I have not here collected in beds which can be decisively referred to that part of the series in which *D. caduceus* has begun to be common and *P. typus* has not yet disappeared. On the other hand, there are apparently beds at Daylesford, above the horizon at which *T. fruticosus* ceases to be common, but older than the beds with abundant *D. bifidus.* This may be only a local unimportant peculiarity of the bed in which the fossils were collected at locality 22.

Tabulation of the fossils observed at the chief localities. The beds grouped together are close to one another, and separated by not many feet in thickness of strata.

——	2	3 4 5	6	11	16	18	20	21	22	41	14 15	25	30 13 32	42 43	44 45	50	53	54
T. fruticosus - -	x	x	x	x	?	?	x	x	-	x	-	-	-	-	-	-	-	-
T. bryonoides - -	-	x	x	-	-	-	-	-	x	x	x	x	x	x	-	-	-	-
T. serra - - -	-	-	x	x	-	-	-	-	-	-	x	x	-	-	-	-	-	-
T. pendens - -	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T. quadribrachiatus	-	x	?	-	-	-	-	-	-	-	x	x	x	-	-	-	-	x
P. typus - - -	x	x	x	x	x	x	-	x	x	x	x	x	x	x	-	-	-	-
P. angustifolius -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-
Dichograptus octo-brachiatus -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	?	-	-
C. flexilis - -	-	-	-	-	-	-	-	-	?	-	-	-	-	-	-	-	-	-
C. abnormis - -	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-
G. thureaui - -	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
G. macer - - -	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Did. bifidus - -	x	-	-	-	-	-	-	-	-	?	x	x	x	x	-	-	-	-
D. cf. nicholsoni -	-	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-
D. extensus - -	-	-	-	-	-	-	-	-	-	-	x	-	-	x	-	-	-	-
D. caduceus - -	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	x	x
D. nitidus - -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x

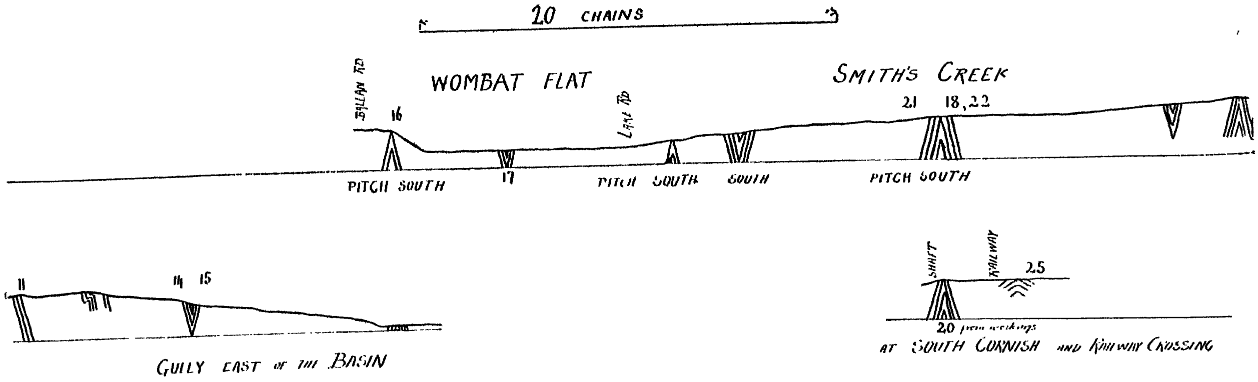


DIAGRAM OF RELATIVE POSITIONS OF FOLDS AND FOSSIL LOCALITIES, SOUTH OF DAYLESFORD

Smith's Creek crosses the folds obliquely, but the distances between the folds are to be taken as at right angles to the folds.

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ART. IX.—*Geology of the Proposed Nillahcootie Water Conservation Area.*

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(With Plate XIII.).

[Read 11th June, 1908].

I.—INTRODUCTION.

Every dry season the Broken Creek, a branch of the Broken River flowing into the Murray, ceases to run, and the result is a water famine over most of the country lying between the Murray and the Broken River. The inlet of Broken Creek from the main river had gradually been silted up, and only flood waters found their way from the river into the creek. Matters were considerably improved by the building of Casey's Weir, just below the point where the flood bed of the creek left the river, and by the cutting of a channel to allow more water to enter Broken Creek. In time of extreme drought the Broken River itself ceases to flow, and consequently even in moderate seasons little or no water finds its way into Broken Creek during the summer months. It was therefore proposed to build a large weir on the Broken River at Nillahcootie, half way between Mansfield and Benalla, in order to conserve sufficient water to keep the Broken Creek continually flowing, even in the dryest seasons, and to supply water for irrigation purposes. A site for a weir was selected just above the junction of Back Creek and the Broken River, and bores and shafts put down in order to test the nature of the underlying rock. The river at this point flows along a gorge about fifty feet deep, cut through solid granite, so that the foundations for the main concrete wall would be perfect.

The proposal was to build a weir about 100 feet in height, and this meant that an embankment over half a mile in length must be built along a neck of land lying between Back Creek and an alluvial flat on the main river. The borings and shafts along this line showed that in places bedrock was not met with till a depth of over seventy feet had been reached, the material passed through being a conglomerate consisting of pebbles set in fine clay, with some gravel in parts, and the conclusion arrived at was that the river had formerly flowed where this bank now stands, and it was considered that the soakage through the river gravels from the reservoir into Back Creek would cause so great a loss of water that the amount conserved would not be sufficient to repay the large initial expense, and further considerable doubt was expressed as to the strength of this ridge, and it was feared that the soakage through this bank might cause a break-away, with disastrous results to the inhabitants of the country lower down the river.

Nothing further was done in the matter until in 1907 the Benalla Water Trust again brought it under the notice of the Minister for Water Supply, who visited the locality and had a fresh report prepared.

I visited the locality with Mr. S. Jeffrey, the Shire Engineer for Benalla, and found that the conglomerate referred to above was of considerable area, and had many of the characteristics of a glacial deposit. Unfortunately the exposures are poor, and it is difficult to determine absolutely whether this deposit is of glacial origin or not; but there is sufficient evidence to show that it would be a great mistake to condemn the scheme until the origin of the conglomerate has been fully worked out. A fresh shaft should be sunk, and the material examined critically by a geologist.

II.—Physiography of the Area.

The valley of the Broken River about Nillahcootie forms the division line between the Strathbogie Ranges and the Mount Samaria and Tolmie Highlands. At the proposed weir site the valley is fairly narrow, and the river bed is gorge-like, but higher up wide open alluvial flats exist, forming a splendid storage area for immense quantities of water.

A few miles below the proposed weir site the valley commences to widen out, and the river flows on through Benalla, over open alluvial plains, and joins the Goulburn at Shepparton. About six miles below Benalla the Broken Creek leaves the main river and runs in a north-westerly and westerly direction to join the Murray.

At Gowangardi the Broken River flows between low hills of silurian sediments, and there is little doubt that this part of its course is of comparatively recent origin, and that Broken Creek was formerly the main stream, the gradual building up of which led to the formation of a newer and shorter course to the Goulburn.

The source of the main stream is in the hills to the north of Mansfield, and it is soon joined in the Parish of Dueran by Bridge Creek and Blue Range Creek, which rise in the Tolmie Highlands, and Thomson's Creek, which rises in the hills to the south. Just at the northern boundary of the Parish of Nillahcootie the river is joined on the west by Sandy Creek, whose source is in the eastern portion of the Strathbogies. About a mile further north Back Creek, with its tributary, Wild Dog Creek, enter the river from the east.

To the west of the river valley at Nillahcootie lies the somewhat dissected pene-plain of the Strathbogie. The general level of this area ranges from a thousand to fifteen hundred feet above sea level, but here and there hills like Mt. Separation and Mt. Barrenhet stand well up above the surrounding country.

On the eastern side the country is more rugged, the ascent from the river being rapid, and in some places precipitous, falls 150ft. high being found on both Back Creek and Wild Dog Creek. The highest point in this neighbourhood is Mt. Samaria, which rises to a height of 3138ft. above sea leved. On the slopes of Mt. Samaria some good grassy flats are met with, but south and east from this point the country is extremely rough, very heavily timbered, and rendered almost impassable by the dense growth of wattle and other scrub. Other prominent hills on the eastern side of the river are Hat Hill and Mt. Wombat. The country above the proposed weir site is fairly open, as the river here flows through undulating country composed of Carboniferous sandstone, and is only separated on the south from the basin of the Goulburn River by a low ridge of similar rocks.

III.—The Geological Sequence.

The rocks of this area may be divided into four groups. (A) A series of sedimentary rocks showing considerable contact metamorphism and probably of Silurian age. (B) Igneous rocks of acid to sub-acid composition intruded into the silurian series and Devonian in age. (C) Conglomerates occupying portions of the valleys of Wild Dog Creek, Back Creek, and the Broken River, probably of glacial origin, and of uncertain age. (D) Recent alluvial deposits along the course of the streams.

(A).—*The Silurian Rocks.*

The sedimentary series consist of indurated mudstones, shales, slates, quartzites, hornfels, etc., the alteration being due to the intrusion of the granites and porphyries. The strike of the rocks is very irregular, but still seems to have a general northerly direction. So far no fossils have been found in these beds, but there is little doubt that they are silurian in age, as they occur on the same line as the fossiliferous sandstones of silurian age occurring at the Reef Hills, Benalla, and the silurian limestones of Loyola, near Mansfield.

Acid apophyses from the granite are to be seen intrusive into the sediments near the contact. The strata are much jointed and faulted, and show considerable contact metamorphism, most of the rocks showing the presence of mica and other secondary minerals. In the bed of Back Creek, about two and a-half miles above its junction with the Broken River, a sharp junction between the sedimentary and igneous rocks is seen, and sections show that the contact rock is a typical hornfels consisting of granular quartz, with a considerable amount of biotite.

(B).—*The Igneous Rocks.*

Three distinct types of acid igneous rocks occur, which may be provisionally called granite, granite porphyry and quartz porphyry.

The granite is only found at the lower levels along the river bed at about 800ft. above sea level. On the eastern side of the river silurian rocks containing acid veins are met with at

about 850ft., and climbing upwards along the surveyed road to Mt. Samaria, these rocks are traversed until a height of 1100ft. is reached, when granite porphyry makes its appearance. The road passes along over this till, at a height of 1500ft., the Silurian rocks reappear, but at 2400ft. they give place to a granite porphyry having a groundmass distinctly finer than the previous occurrence, and the porphyritic felspars are much smaller. On the final slope leading to Mt. Samaria, the prevailing rocks are silurian sediments, but the denudation of these frequently exposes the underlying porphyry, now passing to the quartz porphyry type. Finally at a height of 3138ft. above sea level the summit of Mt. Samaria is found to consist entirely of a quartz porphyry showing phenocrysts of quartz and felspar in a fine-grained groundmass. The northern face of the mount is extremely precipitous, and an imperfect columnar jointing in the porphyry is to be observed. Extending in a north-easterly direction from this point lies the main mass of the porphyry forming the Toombullup and Tolmie Highlands.

On the western side of the river the granite rises to some hundreds of feet above the level of the river. Porphyry occurs also on the Strathbogie side, but this area has not been examined, so that the junction of the two types is not known.

(C).—*The Conglomerate.*

The best development of the conglomerate is met with below the junction of Back Creek and the Broken River, where it reaches a width of 50 chains and is up to 70ft. in thickness. The conglomerate consists of boulders and pebbles of all sizes, set in a fine graned material, the boulders consisting of quartzite, hornfels, indurated mudstone, shales, quartz, granite, granite porphyry, aplite, tourmaline aplite, quartz porphyry, etc. The general size of the boulders is from 1ft. down to an inch or two in diameter, the largest noted being in a small road cutting near Back Creek, where a boulder of granite porphyry over 4ft. long occurs alongside a mass of indurated mudstone about 3ft. in length. Many of the boulders are facetted and polished, but striated boulders are rare, the few that were found not being entirely satisfactory, so that the determination of the conglomerate as of glacial origin at present rests rather on its mode of

occurrence, distribution, form of pebbles, etc., than on the presence of striated boulders.

Very few sections through the conglomerate are met with, the bulk of the material lying in a valley between the present river bed and the hills to the east, and the thickness is only known from the depth of bores and shafts put down along the line originally proposed for the weir site. Unfortunately the shafts have been filled in, so that no information can be obtained in them.

The general distribution of the conglomerate is shown in the accompanying sketch map of the area. The upper portion lies near the base of a steep scarp to the south of Mt. Samaria, and it becomes almost impossible to trace it on account of the fallen material from the scarp in places completely covering the surface. It is in this part, however, that the best section occurs, a small cross valley exposing a thickness of 40ft. of conglomerate. The pebbles are mostly small, being between 2 and 4 inches in diameter, larger ones being rare. Most of the pebbles show facetting, and are all smooth and polished, but no striations were observed. The pebbles consist almost entirely of hard quartzite, and are set in a fine-grained matrix. In general the whole mass is firmly cemented together, and large blocks of conglomerate are found along the bed of the cross valley. At this point the upper part of the conglomerate is about 100ft. above the level of Wild Dog Creek.

Along the Broken River, above its junction with Back Creek, abundant boulders and pebbles occur in the bed of the river, and although now waterworn and showing no signs of facetting, they quite possibly represent resorted glacial material, especially as many of the boulders consist of a dyke rock composed of a soda hornblende, and an alkali felspar, which must have travelled a considerable distance, as no outcrop of such a rock occurs along the stream for many miles above Dawes' Flats, where boulders of it are extremely common.

Along the sides of the valley and well above present flood level, are found pebbles of quartzite resting on the granites, and the form of these pebbles suggests a glacial origin. So far I have had no opportunity of examining the country higher up the valley, where possibly more conglomerate would be found.

Below the junction of Back Creek with the Broken River the conglomerate widens out, and can be traced some distance down the stream, but finally gives place to alluvium and resorted boulders from the conglomerate. About a mile and a-half below the junction a narrow belt of conglomerate joins the main mass on the east. This tributary portion is considerably dissected, but the whole surface of the ground is covered with ferns and scrub, so that very little can be seen of the nature of the material.

The evidence in favour of this conglomerate being of glacial origin is as follows:—

(1) Many of the boulders are facetted, smoothed and polished, and are generally quite unlike water-worn material. Here and there blocks are seen having a portion of its surface smoothed, but the remainder is rough and angular.

(2) The composition of the boulders found in the conglomerate is of an extremely varied character, and although most of them can be matched with the rocks in the district, some are quite distinct from any known rocks in this vicinity, and have probably travelled a considerable distance from the place from which they were derived.

(3) The composition of the boulders seems to bear no relation to the composition of the underlying rock, i.e., a change in the composition of the underlying rock causes no change in the relative proportions of the various types of rocks contained in the conglomerate.

(4) The matrix seems to vary with the composition of the underlying rock, being fine grained and seemingly composed of ground-up sedimentary rocks, where the conglomerate rests on the silurian. Whereas angular quartz is fairly abundant throughout the matrix, where the bedrock consists of granite.

(5) Microscopic sections of the matrix show that the constituent grains are angular to subangular, and so are distinct from rounded water-worn grains.

(6) The distribution of the conglomerate, especially below the junction of Back Creek and the Broken River, where it is over half a mile in width, and about 70ft. in thickness, can be easily explained if we accept the glacial origin of the conglomerate. If the conglomerate be not due to glacial action, then it must be of river formation. From the site originally proposed for the

weir, for some miles down stream the fall of the river is fairly rapid, and there is no apparent cause why the stream should build up its bed over 70ft., and then set to work to carve out a new channel for itself in the granite.

The absence of typical striated boulders is, of course, a strong argument against the glacial origin of the conglomerates, but this absence may be partially explained by the fact that the bulk of the pebbles are composed of quartzite, granite and porphyry. The first named being extremely hard, may have resisted scratching, and only show polishing, and the decomposition of the surface of the igneous rocks would remove all traces of striations, if such had ever been present.

(D).—*Alluvium.*

The distribution of the alluvium is shown in the accompanying map. In part this is rich river wash, but the lower level material is composed mainly of resorted material from the conglomerate with only a small proportion of finer material.

IV.—Petrography.

The igneous rocks of this area may be divided for the time being into granite, granite porphyry and quartz porphyry, the discussion as to their correct nomenclature being reserved until later. Aplitic and pegmatitic veins are associated with the granite.

(A).—*Granite.*

The granites are only found to occur at the lower levels along the valley of the Broken River. The colour of most of the rock is red, this colour being secondary and due to the alteration of the felspars and ferro-magnesian minerals.

The structure of the rock is peculiar, as it has a porphyritic appearance, due to the fact that large blebs of quartz and felspar crystals are set in a granular mixture of quartz and felspar, with here and there a granophyric intergrowth of quartz and felspar. Cross sections of the large quartz grains show a rough hexagonal outline, and the large felspars show fairly perfect crystal boundaries. Flakes of white mica with a pearly lustre are present, and biotite showing considerable alteration is moderately abundant.

Under the microscope the rock is seen to consist of quartz, orthoclase, plagioclase, biotite and muscovite, with minor accessories, such as apatite and magnetite in very small amount. The quartz is clear and colourless, although in parts it is slightly clouded by the numerous bubbles scattered irregularly through it. The larger grains show numerous cracks. Both orthoclase and plagioclase are present, the latter being slightly the more abundant. The orthoclase is very much decomposed, the alteration products being mainly kaolin and secondary mica. Carlsbad twins are fairly common. The orthoclase shows a considerable amount of microperthitic intergrowth, and patches of almost fresh secondary plagioclase occur in the orthoclase. The extinction angles of these secondary felspars show that they are albite. The plagioclase is also very much altered, and the decomposition products in this case are kaolin, secondary mica and zoisite. Many of the felspars are so much decomposed that it is impossible to read the angles of extinction, but one which was much fresher than the remainder gave angles conforming to andesine having the composition $Ab_4.An_3$. This particular crystal is of great interest, as it not only shows twinning according to the carlsbad and albite law, but also according to the maneback and possibly the pericline law. The centre of the mineral has been replaced by a secondary felspar which is quite fresh and shows traces of albite twinning. The ref. index of the secondary felspar is shown by Becke's method to be higher than that of the original mineral, and so belongs to the basic end of the plagioclases. A few of the plagioclases show traces of zoning, but the range of difference in composition is very slight. The muscovite is fresh and occurs in irregular flakes, showing high polarization colours. The biotite is bleached and partially converted to chlorite, with the separation out of iron oxide along the cleavage flakes. Under the microscope the character of the intergrowth of the quartz and felspar is well seen. In part this intergrowth is of a granophyric type, and in part it seems to consist of rounded blebs of quartz set in a large felspar crystal.

(B).—*The Granite Porphyry.*

The granite porphyry has a considerable range in texture, merging in one direction into a porphyritic granite, and in the

other into a quartz porphyry. The hand specimens show that the rock is light grey in colour, and consists of phenocrysts of felspar, with some quartz set in a finer grained ground mass, a comparison of the various types showing that as the groundmass becomes finer in grain, the phenocrysts decrease in size.

Under the microscope the rock is seen to consist of idiomorphic plagioclase phenocrysts, with occasional irregular grains of quartz, set in a hypidiomorphic to granular groundmass of of quartz, plagioclase, orthoclase, with numerous flakes of mica. The felspar phenocrysts in general show good crystallographic boundaries, but some are considerably corroded. A measurement of the extinction angles of one of the phenocrysts, which shows both carlsbad and albite twinning, proved that it was andesine of the composition $Ab_4.An_3$, and therefore similar in composition to the plagioclases of the granite. A second section which showed good zoning gave extinction angles, proving that the central area was an acid andesine, and that the composition ranged from this to an acid oligoclase on the margin.

The groundmass consists of quartz felspar and mica. The quartz, which is clear and colourless, occurs in rounded grains, in which are to be seen bubbles and included needles of apatite. The felspar in the groundmass seems to be mainly plagioclase, but some sections showing an entire absence of twinning are probably orthoclase. By the use of Becke's method the refractive index of the felspars is seen to be generally about the same, or lower than that of quartz, and higher than that of the canada-balsam, so that the felspars are either andesine or oligoclase. Biotite is abundant, some being quite fresh, brown in colour, and showing intense pleochroism, the remainder being more or less converted to green chlorite. Included in the biotite are small crystals of apatite and magnetite, surrounded by pleochroic halos. Magnetite has also separated out along the joint planes in the chloritized mica.

(C).—*The Quartz-porphyry.*

The quartz porphyries are light grey to dark blue grey in colour, and show phenocrysts of quartz and felspar with occasional flakes of mica in a fine grained groundmass. A section

from the foot of Wild Dog Creek Falls shows rounded and corroded crystals of quartz, with numerous corroded felspars set in a micro-crystalline groundmass. The felspars are very much altered, some being so much so that it is impossible to determine even whether they are orthoclase or plagioclase. One of the less altered phenocrysts is andesine approximating to the composition $Ab_1.An_1$. Orthoclase is almost certainly present, as some of the kaolinized felspars, showing not the slightest trace of twinning, contain a micro-perthitic intergrowth of a fresher felspar, which is probably albite. Flakes of biotite are not uncommon, some being fairly fresh, while others are partially or completely altered to a strongly pleochroic chlorite, which gives a change from a brownish green to a light whitish green. Inclusions of apatite and magnetite are fairly abundant. The groundmass is granular and consists of quartz and felspar with minute flakes of chloritized mica. Using Becke's method the felspar is found to have a refractive index lower than that of quartz, and different sections show refractive indices greater, equal to, and less than that of canada-balsam, so that we evidently have orthoclase and an acid plagioclase both present.

A section cut from a specimen obtained from the summit of Mount Samaria, alongside the Trig. station, shows somewhat similar character, but is much finer in the grain. The groundmass is felsitic, and consists of quartz and felspar, with minute flakes of mica. The felspar microlites are too small to determine. Quartz intensely corroded and embayed, and both orthoclase and plagioclase occur as phenocrysts. Flakes of mica are fairly abundant, and garnet, surrounded by a ring of chloritized mica, is present.

(D).—*The Nomenclature of the Rocks.*

Most of the more acid plutonic rocks of Victoria come under the head of grano-diorite, as they have basic felspar in excess of the alkali felspar. In the rock described in this paper the orthoclase is about as plentiful as the plagioclase, and moreover the plagioclase in this case is andesine and not labradorite, the common felspar of grano-diorite. Biotite is not nearly as abundant in this rock as in the grano-diorites of Harcourt and elsewhere.

The name granitite, using it in the English sense as being a granite having approximately equal amounts of orthoclase and plagioclase, fits the description of this rock exceedingly well, the only objection to the name being that it has been used in more than one sense, and its use therefore is likely to lead to confusion.

Harker does not use the term granitite at all, such rocks as the above being included under the heading of granite. Kemp and Merrill also seem to have dropped the term, while Rosenbusch uses it as meaning a biotite granite, that is, one containing no muscovite. All things considered, therefore, the name granite seems to be the most suitable for this rock.

Neither the granite porphyry nor the quartz porphyry conforms to the description of the normal types, as both should contain orthoclase in excess of plagioclase, whereas the bulk of the felspar in both cases, especially the phenocrysts, belongs to the soda-lime series of the plagioclases. Harker divides those intrusive rocks in which quartz phenocrysts are typically absent into porphyry and porphyrite according as the dominant porphyritic constituent is an alkali felspar, or a soda-lime felspar. Extending this definition to cover the quartz rich rocks, we would get granite-porphyrite, and quartz porphyrite as the names for the rocks described in this paper. In the absence of a chemical analysis, however, it is very difficult to estimate the relative proportions of the alkalis to the lime, especially as the groundmass is fairly fine grained, so that pending such analyses the names granite porphyry and quartz porphyry had better be retained. Furthermore, the igneous rocks of this area are distinctly more acid than the main mass of the Strathbogie and Toombullup Ranges, and seem to represent an acid differentiation from a grano-dioritic magma, and the name quartz-porphyrite would be more suitably applied to some of the less acid members of the series, the rocks of this area being an intermediate type between these and the normal quartz-porphyry.

V.—Age and Relations of the Rocks.

The oldest rocks in this area are the sedimentary series which have been shown to be probably of silurian age. During the deposition of these beds, land surface existed a few miles to

the east, as we find a series of shore-line conglomerates occurring along the eastern flank of the Tatong Hills and continuous with these we get the silurian conglomerates which overlie the phosphate beds at Mansfield. The sedimentary series have been much folded and contorted, and have been intruded by the granites and allied rocks. This intrusion is clearly proved by the well-marked contact metamorphism exhibited in the sedimentary rocks near the junction of the two series. The presence of acid veins from the granite intruded into the silurian rocks, gives further evidence as to the relation of the granite to the sedimentary rocks.

This fixes the age of the granites and porphyries as post-silurian, that is if the silurian age of the sediments be accepted. There is no necessity, however, to depend solely on the contact in this area, as the rocks of the Strathbogies certainly belong to the same series, and there is no doubt that they are intruded into the silurian, as contact metamorphism is very marked all along the southern boundary of the Strathbogie massif. The southern extension of the porphyries forming the Toombullup and Tolmie Ranges is covered by sandstones of lower carboniferous age, and there is no sign of contact alteration in these sandstones, so that the porphyries are undoubtedly pre-carboniferous, and consequently belong to some part of the devonian.

The lower devonian was a time of intense earth movement in Victoria, and these earth movements were accompanied by intrusions of igneous rocks, so that there is little doubt that the granites, granite porphyries and quartz porphyries of this area belong to the lower devonian.

The relation of the igneous rocks to one another is exceedingly interesting. The mineral composition of the various types of igneous rocks in the area shows that they have been derived from a common magma, in which very little differentiation has taken place. From Mount Samaria to the Broken River we get an ideal section illustrating the effect of pressure on a consolidating magma, the increase of coarseness of grain of the constituent minerals being to a certain extent proportional to the increase of pressure under which the minerals crystallized. Commencing at Mount Samaria with a quartz porphyry having an exceedingly fine groundmass, we pass to the porphyry at Wild

Dog Creek Falls, having a fairly coarse granular groundmass. From this we pass to a granite porphyry, which in itself shows an increase of coarseness of grain as we descend the hill, and finally to the coarse-grained plutonic granite occurring along the river nearly 2400ft. below the summit of the hill.

In devonian time the highlands were continuous from the Strathbogies across the present valley of the Broken River to the Toombullup Ranges, and this ridge formed the northern boundary of the basin in which the carboniferous sandstones were laid down.

So far I have only examined the carboniferous sandstones sufficiently to show that they are younger than the granites and porphyries which underlie them. The age of the conglomerate is extremely doubtful. They are certainly post-carboniferous as fragments of carboniferous sandstones are present in them. If of alluvial origin they are probably of pliocene age, but if of glacial origin they may go back as far as permo-carboniferous. To the north Mr. A. E. Kitson records several patches of conglomerates of glacial origin at Greta, Taminick and Glenrowan, and suggests that they are possibly permo-carboniferous in age, from their general similarity to the conglomerates of Bacchus Marsh.

Suitability of Area for Water Conservation.

In considering the suitability of the area for water conservation purposes it is necessary to discuss the geological features of the area of the reservoir, the catchment area, and more briefly the area to be served.

The reservoir area is bounded on the east and west mainly by granitic rocks with some silurian sediments on the eastern side. The south and south westward boundaries are composed of carboniferous sandstones. High level alluvium may border portion of the area, but if this were stripped off it would be seen that the proposed reservoir was surrounded on all sides except a narrow outlet to the north by rocks of palaeozoic age. This then should give a basin from which very little soakage could take place, the only parts where slight loss might be expected being along the junctions of the different series and down any fault and joint planes present in the rocks.

The northern boundary of the reservoir would consist of a concrete wall running from the western granite margin across the river bed to the granite at the other side of the bed, and then continued by an embankment resting on portion of the conglomerate beds unless it were found necessary to run the concrete wall right across the northern end of the reservoir. If, as seems probable, this conglomerate is of glacial origin, then there is certainly no necessity to sink through these beds in order to let the foundations of the concrete into bed-rock, as the conglomerate itself would possess quite as good holding powers as the underlying granite and silurian. Should the conglomerate on further investigation be proved to be of glacial origin then the loss by soakage through it might be taken as being nil, and there could be no doubt about the suitability of the area for a weir site.

On the other hand there is the possibility of the conglomerate turning out to be due to river action, and then there would be the chance of a considerable loss by soakage unless the concrete weir was let into the underlying rock. Further, there would be no comparison between the holding strength of such a river deposit, and a conglomerate of glacial origin. The sinking of a single shaft through these beds should settle definitely their origin and give a sure basis on which to estimate the probable cost of the weir.

The catchment area requires very little comment. The whole area is practically surrounded by well-wooded hills, and as the structure of the country is similar to that of the reservoir area there would be little loss of water, because the water which did soak into the ground on the hill sides could find no outlet except into the reservoir. Shut in as it is by hills the loss of water from the reservoir by evaporation would be small. The standard of purity of the water should be high, especially that derived from Back Creek and Sandy Creek, flowing as they do mainly over granitic rocks. The water which comes down the main river in flood time carries a considerable amount of red sediment in suspension derived from the carboniferous rocks. but the water contains very little dissolved matter. The area to be served is part of the Murray Plains, which have apparently been formed by the building up of the whole engrafted Murray

River system consequent on the extension of the length of the river owing to the formation of the coastal plains of South Australia. This being so, it follows that this area was formerly part of an extensive peneplain, the somewhat irregular surface of the country at that time consisting of the older palaeozoic rocks with only a small proportion of alluvium. The building up of the country would be gradual, and the various streams would constantly change their beds, so that bands of sand and gravel should be found in various parts of the alluvial deposits indicating former stream channels. A considerable amount of the reclamation would be due to deposition of fine silt during flood times, so that the general structure of the alluvial deposits would consist of irregularly bedded clayey material, with "horses" of coarser material formed along former main stream courses.

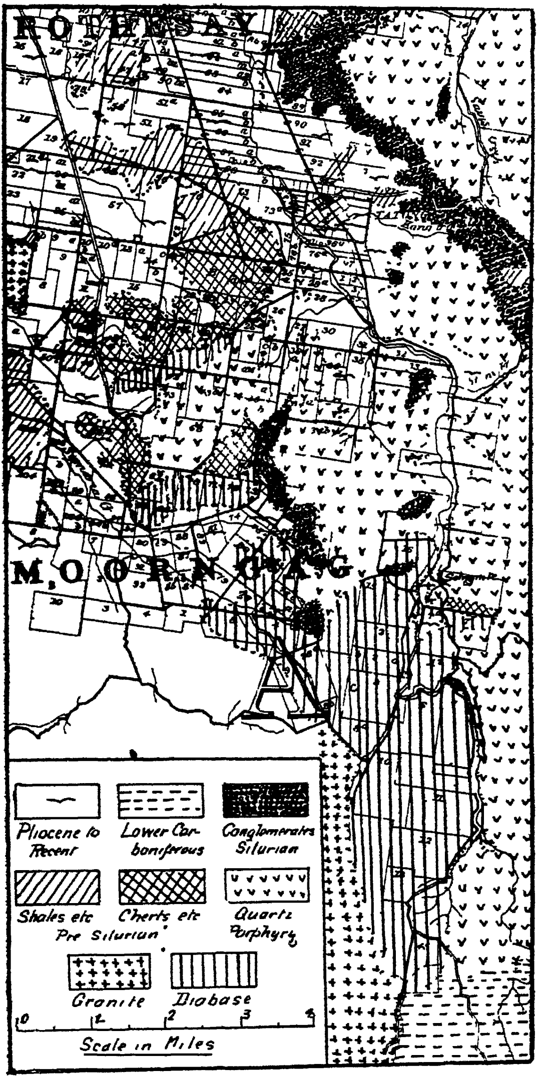
In any channelling which might be required for irrigation purposes it would be necessary to guard against loss through soakage into the sand and gravel beds. If the structure be as indicated, it follows that there would be an unequal distribution of the underground water, as the supply at any place would depend on the surface contour of the old pene-plane, and on the distribution of the sand and gravel beds throughout the finer-grained clayey material. This means that it will not follow that a plentiful supply of water will be found in any part of this area because a good well exists on a neighbouring farm.

It is therefore certain that wells cannot be depended on to give an adequate supply of water over the whole area, and this country must depend on large dams or on a supply derived from some large reservoir.

Summary.

1. The general physiography of the area is described, and it is pointed out that Broken Creek represents the former main course of the Broken River, the present bed of the river from the junction to Shepparton being of comparatively recent origin.

2. The geological sequence of the rocks in the proposed water conservation area is set out, particular attention being directed to beds of conglomerate, the origin of which is to a certain extent in doubt.


ROTHESAY
MOORNGAG
Pliocene to Recent
Lower Carboniferous
Conglomerates Silurian
Shales etc
Cherts etc
Pre Silurian
Quartz Porphyry
Granite
Diabase
0 1 2 3 4
Scale in Miles

[Proc. Roy. Soc. Victoria, 21 (N.S.), Pt. I., 1908.]

Art. X.—*On the Evidence of the Origin, Age, and Alteration of the Rocks near Heathcote, Victoria.*

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(Professor of Geology in the University of Melbourne).

(With Plates XIV.-XVIII.).

[Read 11th June, 1908].

1.—INTRODUCTION.

Victorian geology abounds with problems for the solution of which conflicting hypotheses have been proposed by different observers. Among these controverted questions none is of greater interest and importance than the one with which this paper is concerned, and few present greater difficulties in the way of a completely satisfactory solution.

The problem may be stated briefly to be the origin and age of certain basic and acid igneous rocks, their relations to cherty and jasperoid series, which generally accompany them, and the relations of all the above to the Silurian and to the Ordovician rocks of the district.

The work of mapping the area presents considerable difficulty, as over a considerable part of the district rock-junctions are hard to find, and when found the relations of the rocks to one another are not easy to interpret. Furthermore both igneous and sedimentary rocks have in places been so altered that it is not surprising that different observers have interpreted the geology in different ways. Microscopic examination of the rocks helps considerably in following the interesting series of metamorphic and metasomatic changes which the rocks have undergone, but partly as a consequence of these changes some of the questions which ordinarily an appeal to the microscope would have settled, remain to some extent unsolved.

Heathcote lies about 74 miles north of Melbourne, on the Bendigo road, and within the valley of the McIvor Creek. The field observations in this paper are the outcome of several visits to the district. I have been assisted in my observations by my assistants, Mr. H. J. Grayson and Mr. H. S. Summers, M.Sc., and during one visit of four days by the members of the Geological class of the University of Melbourne. The area visited extends from Photograph Knob, in S. Heathcote, on the south, to a little beyond Lady's Pass, in Dargile, on the north. The junctions of the Ordovician rocks with the cherts and with the igneous rocks in this area, have been carefully examined in the field, collections of the rocks have been made, and about 80 rock sections have been examined. Both in the field and in the laboratory the hypotheses and evidence of previous workers have been examined in conjunction with my own observations. Further work, over a more extended area is necessary before all the obscure questions in Heathcote geology can be resolved. In this communication certain questions raised in previous papers are reviewed, a number of hitherto unrecorded observations are set out, and their bearing on earlier evidence and hypotheses is considered. I hope at a later date to deal with the evidence from the Northern and the Southern extensions of these rocks, and meanwhile offer this paper as a contribution of facts and of tentative conclusions from them, which it is hoped will be of some service towards the solution of the problems of the district.

2.—Previous Literature.

1. Geol. Sketch Map of Victoria, by Selwyn, 1866. The rocks of the Heathcote district, apart from Lower and U. Silurian, were marked as trap and described (p. 172) as dykes.

2. Descriptive Catalogue of the Rock Specimens and Minerals in the National Museum, Melbourne, by Selwyn, 1868. On page 16 the rock from Mt. Camel was described as diabase, but in the list of errata the name was changed to diorite, as the ferro-magnesian mineral was identified as hornblende, and not pyroxene. On p. 18 the substance named "Selwynite," then regarded as a mineral, was described as "in a vein in the U. Silurian rocks," indicating Selwyn's view that the basic rocks were intruded in post Silurian times.

3. *Dunn, E. J.* "Notes on the Geological Features of Heathcote and Neighbouring Parishes." Quarterly Rep. Min. Dep. Victoria, Dec. 31st, 1888, pp. 76-77. In this paper Mr. Dunn briefly described the rock series. The granitic-like rocks he regarded as syenite . . . "schistose beds, in part serpentinous, are exposed in the railway cutting south of the town. Decomposed intrusive rock is abundantly represented in them. . . . A boss of intrusive rock (greenstone) occurs on the south side of the creek, and about a mile west of the post office." Mr. Dunn stated that carbonate of magnesia is abundant in botryoidal masses in the older Silurian (Ordovician) rocks. A reef worked 1 mile S. 20 deg. W. of Tooboorac, according to Mr. Dunn, is in highly altered Silurian (Ordovician) rocks (micaceous sandstones).

4. In a letter sent to the Mines Department on July 6th, 1891, but only recently published (Records Geol. Surv. Victoria, Vol. II., Part I., 1907), Mr. Dunn asserted the pre-Silurian (pre-Ordovician) age of some of the Heathcote rocks. He says: "The formation is of pre-Silurian age, and the beds of which it consists comprise highly silicious and jaspideous rocks, very talcose splintery schists, tufaceous deposits, quartzite and ancient vesicular basalts, once surface flows but now intercalated with other strata." Mr. Dunn then suggested that these rocks have marked resemblances to the rocks of the Te Anau series in New Zealand.

5. *Lidgey, E.* "Notes on Quarter Sheet, No. 80, N.W.—Parishes of Dargile, Heathcote, Costerfield and Knowsley." Prog. Rep. Geol. Surv. Victoria, No. VIII., 1894, pp. 44-46. Mr. Lidgey described the Metamorphic rocks as consisting of "basic lavas and amygdaloidal rocks, tuffs, agglomerates, varieties of jasper, cherty rocks, and talcose, and chloritic schists." In the description of the Lower Silurian (Ordovician) rocks he recorded the finding of trilobite fragments in a micaceous mudstone from a paddock marked 3N., T. Blake, in the parish map of Knowsley East. He further noted that some of the Silurian conglomerates contained pebbles of the metamorphic rocks.

6. *Etheridge, R., Junr.* "Evidence of the existence of a Cambrian Fauna in Victoria." Proc. Roy. Soc. Victoria, new ser., Vol. VIII., 1896, pp. 52-56, pl. I. Mr. Etheridge examined the trilobite fragments collected from Knowsley East, described

a form by the name of *Dinesus ida*, and referred it to the Cambrian series.

7. The above paper is also referred to in Mon. Prog. Rep. Geol. Surv. Victoria, No. 11, 1900, p. 26.

8. *Howitt, A. W.* "Notes on Diabase and adjacent formations of the Heathcote District." Special Rep. Dep. Mines, Victoria, 1896; 16 pp., 3 pl. and maps [with appendix by E. Lidgey, p. 15].

Mr. Howitt described the more acid igneous rocks as plagioclase aplites and felspar porphyrites, and the more basic rocks as hornblende diorites, and varieties of diabasic rocks, including diabase porphyrites, compact diabase, diabase schists, breccias and extremely altered rocks. To some of these altered rocks he applied the term spilite, and he noted that in the "regenerated rocks" the original structure of the rock has been more or less completely lost, and replaced by calcite, quartz and epidote, and in other cases the rock now consists entirely of actinolite. The cherty rocks were regarded by Mr. Howitt as having been produced by the alteration of Lower Silurian (Ordovician) shales by the intrusion first of the diabase, and later of the granitic rocks. The general characters of these cherty rocks reminded Mr. Howitt of adinoles, although he pointed out that an analysis made of one of the cherty rocks showed a much higher silica and a much lower soda percentage than is characteristic of the typical adinoles. Mr. Howitt suggested by analogy with other areas in Victoria, that the probable age of the intrusion of the igneous rocks was the close of the Silurian or the earlier part of the Devonian period.

Mr. Lidgey, in an appendix to Mr. Howitt's paper, withdrew his previous opinion that the diabases were lava flows interbedded with the Ordovician series, and agrees with Mr. Howitt that they were intrusive, and have altered the Ordovician sediments for a distance of 2 to 15 chains from the diabase contact. With Mr. Howitt's paper are included a general geological map of the area on a scale of 2 miles to an inch, and four smaller maps of parts of the area on the scale of 2 inches to a mile. The names of the Geological surveyors are not given, but I gather that Mr. O. A. L. Whitelaw mapped the small area, including the parish of Heathcote, and that Mr. Lidgey was

responsible for the general map and the remaining three smaller areas.

9. *Ferguson*, *W. H.* "Report on an area of Cambrian rocks at Heathcote." Monthly Prog. Rep. Geol. Surv. Victoria, No. 2, 1899, pp. 23-25, 1 pl. Mr. Ferguson defined on a sketch geological map the boundaries of the beds containing the Dinesus fauna, adopting as their upper and western boundary with the Ordovician a thin bed of "brecciated-conglomerate." Ferguson stated that the trilobites were found in block 3.I., parish of Knowsley East.

10. *T. S. Hall.* "Supposed Graptolites from Heathcote." Mon. Prog. Rep. Geol. Surv. Victoria, No. 11, 1900, p. 26. Mr. Hall was unable to identify with certainty any of the remains submitted to him. He stated that graptolites of the Bryograptus type were probably present.

11. *Gregory, J. W.* "The Heathcotian, a Pre-Ordovician Series, and its Distribution in Victoria." Proc. Roy. Soc. Victoria, Vol. XV. (New Series), Pt. II., 1903, pl. 4. Professor Gregory discussed the previous literature, examined further trilobite remains from Knowsley East, and showed that the original *Dinesus* described contained two genera. The new genus he named *Notasaphus*, and suggested that the *Dinesus* beds be included in the Ordovician, as its lowest representative along the Heathcote line. He agreed with Mr. Howitt in the determination of most of the rocks, but Mr. Howitt's "adinoles" he described as black cherts and the aplite of Mr. Howitt he regarded as fine-grained grano-diorite. He recorded fragments of diabase from the Silurian quartzites near the "Copper mine," and hence regarded the diabases as pre-Silurian. The relations of the cherts, schists and diabase with the Ordovician rocks are discussed, and he regarded the series as of pre-Ordovician age. This view was based partly upon his field observations and petrographic work, but also largely on the evidence of the geological mapping of the district, and on the absence of dykes intrusive into the Ordovician series.

Prof. Gregory claimed that "Heathcotian rocks" of pre-Ordovician age occur also at Dookie, under the Silurian rocks of Rushworth, W. and N.W. of Geelong in the valleys of the Barwon and the Moorabool, at Mt. Stavely in W. Victoria, prob-

ably also at Waratah Bay, C. Liptrap, and possibly on the Howqua River. He explained the distribution of the Ordovician and Silurian rocks of Victoria in relation to an old Heathcotian land surface stretching across Victoria, and in conclusion suggested a subdivision of the Silurian rocks of Victoria into an upper, or Yeringian, and a lower, or Melbournian, series.

The following papers do not deal with the Heathcote district, but the authors correlate or contrast some of the rocks described with the typical "Heathcote" series.

12. *Stirling, James.* "Report on Examination of Reefs at Howqua Valley." Quarterly Rep. Min. Registrar, Victoria, June 30th, 1888, p. 70. In this brief report Mr. Stirling states that Malcolm's reef is situated at Malcolm's Creek, about one mile above its junction with Lick-hole Creek. It occurs in a dense blue crystalline rock, like certain massive diorites.

13. *Stirling, James.* "Preliminary report on the Geology of Dookie District," with map and two sketch sections, ibid. pp. 76-77. Mr. Stirling described the structure as follows:—"The rocks are mainly U. Silurian sediments, intruded upon by certain diorites, gabbros, etc.; the latter have in most cases effected induration or hardening of the former along the contacts, and in some places have caused segregations of iron ore, chiefly carbonates and oxides. . . . Near Dookie College, ascending the S.W. slopes of Mount Major, the sediments are indurated, the sandstones become flinty and converted into hornfels. . . . Towards the summit of the hill outcrops of hard silicious rocks are seen to be commingled with irregular bands of ironstone."

14. *Ferguson, W. H.* "Report on Sketch Survey of Eastern Portion of County of Moira." Monthly Prog. Rep. Geol. Surv. Victoria, No. 10, Jan., 1900, p. 10. The altered rocks of Dookie are regarded by Mr. Ferguson as quite distinct from the Silurian rocks or their metamorphosed representatives. They consist of cherts, quartzites, talcose schists, and ironstone and quartz rocks. Diorites and other eruptive rocks cover large areas. The district is traversed by a great number of dykes.

15. *E. J. Dunn.* The Settlers' Guide, Victoria, 1905, p. 60. To a pre-Ordovician (Heathcotian) age Mr. Dunn refers the rocks of Heathcote and Mansfield, and says minor outcrops occur in several other areas. Black slates on the Divide west of the

Macallister River, and the "black slates" of Hedi are, according to Mr. Dunn, probably referable to the pre-Ordovician. On the map, besides the Heathcote and Mt. Stavely areas, a narrow strip east of Walhalla is included in the Heathcotian series.

16. *Howitt, A. M.* "Report on the Edi-Myrrhee Turquoise Belt and the Chert and Jasper Beds near Tatong, County of Delatite, with Plan." Rec. Geol, Surv. Victoria, Vol. I., Pt. 4, 1906, p. 239. Mr. Howitt described the series of cherts, jaspers, etc., occurring in the district, and on lithological grounds classed them as Heathcotian.

17. *Howitt, A. M.* "Reports on the Phosphate of Alumina Beds near Mansfield, County of Delatite," with plan (Plate xxvii.), ibid. pp. 245-247. On p. 246 Mr. Howitt states: "In allotment 16A and 16B, parish of Loyala, phosphatic beds are associated with black and green cherts containing fragments of trilobites and brachiopods." Mr. Howitt compared these with the Heathcotian series.

18. *Dunn, E. J.* "The Iron Mask Ferro-Manganese Mine, near Buchan, E. Gippsland." Rec. Geol, Surv. Victoria, Vol. II., Part 2, 1907, p. 49. Mr. Dunn stated that Heathcotian rocks are probably represented near this locality. Further on he said: "Five miles on a road east of south from Buchan is a ridge running northerly from a portion of the Mt. Tara Range. . . . Here occur ferruginous, highly siliceous beds approaching jasper, in cherts, probably Heathcotian."

19. *Dunn, E. J.* "The Mt. Tara Goldfield, E. Gippsland." ibid. p. 46. Cherty rocks which occur at the Taedato Creek gold workings are claimed by Mr. Dunn as being of Heathcotian age.

20. *Dunn, E. J.* "Red Jasper in the Heathcotian rocks of Tooleen." ibid. p. 81. These are met with on the main road to Rushworth, and have been traced over an outcrop of half a mile in length and one chain in width, and are associated with an ancient igneous rock.

21. *Dunn, E. J.* "General Geological notes on the country between Omeo and Limestone Creek, County of Benambra." ibid. p. 131. Two and a-half miles W. 30 deg. N. of the hut on Limestone Creek, silicified schists permeated with quartz veins were met with, and striking N. 30 deg. E. They present a strong

resemblance to the Heathcotian series. About four miles N. 20 deg. W. from the hut on the Limestone Creek, near the head of Horseyard Creek, occurs a band of red jasper rocks interbedded with green schists.

22. *Dunn, E. J.* "On Mt. Wellington Corundum." "Mining Standard," October 16th, 1907. Mr. Dunn briefly describes the relations of the corundum to the serpentine area and the relations of the serpentine with the U. Ordovician shales.

23. *Hall, T. S.* "Excursion to Mt. William, Lancefield." "Victorian Naturalist," Vol. XXV., No. 1, May, 1908, pp. 9-11. In this account Dr. Hall records the silicification of the shales of the Lancefield beds near the disused Mt. William railway station, and states that the shales high up on the flanks of Mt. William are much indurated, and are succeeded by diabase or greenstone. He says: "There can be but little doubt that the Ordovician is older than the diabase, and has been silicified by its intrusion."

24. *Summers, H. S.* "On the Cherts and Diabases of Tatong." Read at Roy. Soc. Victoria, April, 1908, and published in this volume. Mr. Summers discussed the relations of the cherts and diabases in this area, which had been previously partially described by Mr. A. M. Howitt, of the Geological Survey of Victoria. He showed that the cherts were in places clearly interbedded with unaltered sediments mapped by Mr. Howitt as Ordovician on lithological grounds.

25. *Thiele, E. O.* Read at Roy. Soc. Victoria, May, 1908, and published in this volume. Mr. Thiele in a previous paper (Vic. Nat., vol. xxii., 1905, p. 24) had recorded the finding of U. Ordovician graptolites in black shales closely associated with the Serpentine area, near Mt. Wellington. In this paper he discusses fully the relations of the Serpentine to the sedimentary rocks of the district, and demonstrates that some of the black cherts which occur near the Serpentine contain recognisable U. Ordovician graptolites. The silicification of the shales is thus shown to be of post U. Ordovician age.

3.—Discussion of Previous Literature.

The foregoing list of papers shows that the literature on the Heathcote and apparently related districts is a lengthy one. My

first visit to Heathcote for various reasons was deferred till February, 1908, but during the last three years I have made myself familiar with the most important papers on the district, and their perusal left me in doubt as to the balance of evidence adduced in favour of the pre-Ordovician and post-Ordovician hypotheses respectively of the age of the cherts, diabases and granite rocks of the district. At the same time various points of criticism suggested themselves as to which special examination in the field and with the microscope might be expected to be fruitful in results.

The age of the older sediments has been the subject of debate, as Mr. Etheridge described the *Dinesus* as a Cambrian form, while Prof. Gregory has shown reasons for including the beds containing the trilobites with the Ordovician as its basal member. The age of the normal older sediments is recorded as Ordovician on lithological grounds, as no fossils had been found in them. No real objection can be taken to this view, because at various points in the field they are recorded as succeeding the *Dinesus* beds, show similar dips and strikes, and are only separated from them by a narrow brecciated conglomerate a few inches in thickness.

The great stratigraphical problem is, of course, the relations of the cherts, jasperoids, diabases, and granitic rocks to one another and to the normal Ordovician sediments, and apart from the geological mapping the most important contributions are the paper by Mr. Howitt, in which the post-Ordovician age of the diabases and granitic rocks is asserted, and those of Mr. Dunn and Professor Gregory, in which a pre-Ordovician age is claimed for the igneous rocks and cherts. Mr. Dunn's first paper in 1888 is purely descriptive, and does not deal with the relative ages of the rocks. In his letter to the Mines Department, in 1891, however, he definitely states the pre-Silurian (pre-Ordovician) age of the cherty and igneous series. It is difficult to discuss Mr. Dunn's communication, because he does not present the evidence on which he based his claim for the pre-Ordovician age of the rocks, but his view was evidently based on considerable work in the district, since he states (Rec. Geol, Surv. Victoria, Vol. II., Part II., 1907, p. 81), that he had mapped the rocks of the area and sent the map to the Mines Department in 1892, but that the map had been lost.

Mr. Howitt's paper bears evidence of most careful petrological examination of the rocks, and his examination led him to the conviction that many of the rocks were of an intrusive character. This view he tested in the field. Mr. Lidgey was then mapping the area, and had come to the conclusion that the diabase was interbedded with metamorphosed Silurian (Ordovician) sediments. Mr. Howitt got Mr. Lidgey to re-examine the evidence in the field, and as a result of this he found evidence of alteration in the Ordovicians. The nature of the alteration of the Ordovician relied on by Mr. Howitt was first a bleaching of the sediments by the elimination of organic matter, then molecular rearrangement, and in extreme cases silicification to "adinoles" with over 90 per cent. of Silica.

While the intrusive character of some of the igneous rocks was placed beyond a doubt by Mr. Howitt's petrological work, I think the evidence given of contact alteration by the diabase was of a less convincing character. For instance, he does not discuss the evidence of the maps published with his paper, in which, while cherts are shown between the diabase and Ordivician in some places, in others unaltered Ordovician is shown on the maps in contact with diabase, regarded by Mr. Howitt as intrusive. Further, the silicification of sediments to cherts, as the result of intrusions of diabase, is a distinctly unusual type of purely contact metamorphism, which would seem to merit some discussion, especially as among the altered diabases he records silicified rocks. However, the feature noticed by Mr. Howitt south of Mt. Camel that the Ordovician rocks which are silicified become less so away from the contact, is certainly significant.

Mr. Howitt's view that the intrusion of the igneous rocks occurred probably in Devonian times appears to have been based upon analogy with the age of other intrusive masses, and not upon definite field evidence. Less weight, therefore, attaches to this view than to his conclusions as to the relations of the igneous rocks to the Ordovician series, especially as Lidgey reported the occurrence of metamorphic rocks in the Silurian conglomerates of Mt. Ida. Professor Gregory's paper, in which he supports Mr. Dunn's view of the pre-Ordovician age of the cherts and igneous rocks, is of a very suggestive and far-reaching character.

In discussing the relations of the Heathcote rocks to the Silurian, Prof. Gregory records fragments of diabase in the matrix of the basal Silurian rocks of the Copper mine. This, together with Lidgey's record of pebbles of metamorphic rock in the Silurians, certainly indicates a pre-Silurian age for the diabase and cherts.

The evidence which Prof. Gregory quotes of the relations of the diabase to the Ordovician is of a less direct character. He states that in places he found no evidence of alteration at the contact. At Red Hill, where schistose rocks occur between the diabase and unaltered Ordovician, he was unable to find either a sharp junction or a passage from schists to Ordovician, but on microscopic examination was always able to say whether a rock belonged to the schistose or to the Ordovician series. It seems to me that these determinations under the microscope should be interpreted very cautiously where the field evidence is not clear, inasmuch as two sections cut from rocks of the same series might easily present very different microscopic characters if one were unaltered and the other highly altered.

On p. 161 Prof. Gregory refers to Craven's paddock, in Knowsley parish, allotment 32, where he says: "The two rocks can be well seen in contact close along the eastern fence. Here, as elsewhere, the junction between the hard cherts of the metamorphic series and the normal slates and sandstones of the Ordovician series can be clearly recognised." The statement of locality is almost certainly a misprint for Knowsley East, as the diabase series does not occur in Knowsley. The name of Craven does not appear on the map, and allotment 32 does not occur along the line of the metamorphic or diabasic rocks. The number of the allotment is probably wrongly stated, and this is unfortunate, as Professor Gregory's statement implies the occurrence of a discontinuity at this point between the cherts and the normal Ordovician.

Professor Gregory comments on the absence of dykes from the igneous rocks intruding the Ordovician and Silurian rocks, and regards this as important negative evidence of the pre-Ordovician age of the igneous rocks. He lays great stress on the evidence afforded by the geological maps, which he claims is inconsistent with the view of Mr. Howitt that the igneous series is

post Ordovician, and proves that the Ordovicians are resting unconformably upon the cherts and diabases. In several of the cases mentioned by Prof. Gregory he did not verify the mapping. From among a number two cases may be cited. From the northern boundary of the Heathcote parish diabase is shown in contact with the Ordovician for two and a-half miles to the west of the northern end of the township, and along the whole of this line no metamorphic rocks are shown between the Ordovician and diabase series.

In S. Heathcote, again, a patch of metamorphic rocks is shown in allotments Nos. 15 and 16, where a bay represented on the map as unaltered Ordovician runs up between the diabase on the north and an intrusion of Felspar porphyrite on the south-east.

It must be admitted that the simplest explanation of the mapping at the latter point is, as Prof. Gregory stated, that the Ordovician rests unconformably upon the cherts and diabases. It seemed to me to be a case where the field evidence should be closely examined. All the other cases mentioned by Prof. Gregory seem to me to be susceptible of an alternative, if less simple, explanation. It is admitted that in the areas mapped as diabase there occur intrusive rocks, lava flows and fragmental rocks (agglomerates, etc.). Apart from the question of the mapping accurately representing the relations of the rocks, we have then the possibility that the apparently capricious distribution of cherty rocks might stand in relation to the proximity of intrusive rocks, and that the appearances claimed by Prof. Gregory of the unaltered Ordovician resting unconformably on the diabase might be explained by the overlapping of lava flows of diabase or diabase tuffs over different members of the Ordovician series. In this way it would be possible to explain the absence of alteration in certain parts, as recorded on the map. Mr. Howitt's evidence, and especially the variability of silicification of the Ordovicians with the distance from the diabase, was in apparent conflict with that adduced by Prof. Gregory. Much of the latter is, as he notes, of a negative character, and the positive evidence is possibly susceptible of another interpretation.

I felt that neither view was so firmly based but that further evidence, especially of a positive character, if available, would serve to strengthen one or other of the rival views. I therefore

entered on field work in the district with the intention of examining the field evidence as closely as the time at my disposal would permit. My attention was largely directed to the relations of the igneous rocks to the Ordovicians, and to the black cherts, and I paid particular attention to the areas above cited, and notably the occurrences at S. Heathcote, just north of Photograph Knob, and now present the results of my investigations.

4.—Relations of the Igneous Rocks to the Silurian Series.

S. Heathcote.—Behind and for some distance to the north-west of the S. Heathcote Hotel, silicified and chertified diabase, and in places a mixed selwynite and carbonate rock occurs, forming the western boundary of the McIvor Creek. The Silurian rocks, mainly sandstones and quartzites, outcrop on the opposite side of the creek, and just below the hotel are seen in section in the stream, near where scheelite was found some years ago. No actual contact, howver, could be seen.

Heathcote.—Within the limits of the township the relations between the two series are everywhere obscured by the recent alluvium deposited by the McIvor Creek.

Near the "selwynite" Outcrop.—This occurs about 2½ miles north of the township, on the Murray Road, on the west side, and just north of the junction of the road running N.W. towards Derrinal. Selwyn described this substance as "in a vein in the Silurian." There can, however, be no doubt that it is within the diabase area, although very close to the junction, as diabase in situ occurs in a small gully on the east side of the road. The selwynite appears to be a peculiar modification of the diabase. Near here Prof. Gregory states that sections of the basal Silurian rocks contained fragments of diabase. I have had sections of some of these rocks made, and there occurs in some of them small iron-stained areas which may very likely be decomposed diabase fragments, although I am unable, owing to their iron-stained character, to be certain of their nature.

About 3 Miles N. of selwynite Outcrop.—A road joining the Murray road and running between paddocks 3m and 3j towards the isolated diabase mass in Tranter's paddock, Knowsley East,

crosses a small creek by a bridge within 20 yards of the Murray road. The Silurian is mapped as being "in situ" on the east side of the Murray road, and beneath the bridge in the bed of the creek are large blocks of Silurian quartzite and conglomerate not "in situ," but evidently derived from rocks near at hand. These blocks in several instances contained pebbles and angular fragments of black cherts. Microscopic examination of these chert fragments shows that they are petrologically indistinguishable from the black cherts of Lady's Pass, and near Red Hill. This corroborates Lidgey's evidence, and shows Professor Gregory was right in claiming the cherts, and presumably the diabase, as of pre-Silurian age.

5.—Relations of the Igneous Rocks and Black Cherts to the Ordovician Series.

This problem is the most obscure of all those which arise in the Heathcote district, and, as the previous literature shows, Professor Gregory and Mr. Howitt have given explanations of the relations of the two series which are mutually conflicting. Mr. Howitt claimed that the diabase has everywhere altered the Ordovician rocks for some distance from the contact, the nature of the alteration in places being bleaching and the formation of secondary micas in the shales, and in other cases the silicification of the shales ultimately to black cherts. Professor Gregory has not dealt with this aspect of the question except to state that in several localities, some of which he cited, the Ordovician at the contact with the diabase was quite unaltered.

I have followed the line of contact of these two series from Photograph Knob in the S.E., almost continuously to three miles north of the selwynite outcrop in the northern part of the area, and without at this stage discussing the origin of the alteration wherever I have examined them. I have found the Ordovician rocks silicified near the junction with the diabase to a greater or lesser extent. On the accompanying sketch Geological map (Pl. XVIII.) I have indicated this by a series of dots added to the horizontal shading, which represents the Ordovician rocks. The map is based upon those published in Mr. Howitt's report by Messrs. Lidgey and O. A. L. Whitelaw. The boundaries of the

Silurian, Pliocene and Alluvial deposits I have accepted without confirmation, as the problems discussed in this paper are not materially concerned with these rocks. The boundaries of the igneous rocks and of the diabase Ordovician junction I have examined fairly closely, and while not claiming that the revised boundaries I have laid down are absolutely accurate in every detail, I feel confident they represent a sufficiently close approximation to the true relations for the purposes of a sketch map and for this discussion. In that part of the map dealing with the junctions of diabase and Ordovician I have made some important modifications. The marginal silicification of the Ordovicians is represented by dotted lines. The interesting relations near Photograph Knob have been closely examined (see Sketch Section), and I have come to the conclusion that the bay of unaltered Ordovician represented on the map in Mr. Howitt's report just north of the felspar porphyrite, is in reality diabase tuff and silicified diabase approaching a chert, while the patch marked metamorphic has no defined boundaries, and is really highly silicified diabase and diabase tuff. Probably a dense bluish grey rock which is represented here was accepted by the author of the map, and apparently by Prof. Gregory, as a blue Ordovician shale. It shows, however, no sign of bedding, and in section under the microscope (Sect. 614) differs from the shales (Sect. 574) by showing an absence of bedding and of micaceous flakes. It appears to consist almost wholly of chloritic or serpentinous alterations of a basic rock, probably a tuff. A foliated bluish grey rock of somewhat similar character is seen in section in a small gully immediately south of Photograph Knob, and a similar rock (Sect. 597), splitting readily into long semi-prismatic masses, occurs in paddock 17c, about a quarter of a mile S.E. of Photograph Knob, and within the boundary mapped as diabase. The same rock has then in one place been mapped as unaltered Ordovician, and a little further to the S.E. as diabase. There can be little doubt that both outcrops are related to the igneous series, and probably represent fine-grained consolidated diabase tuffs. This is supported by the fact that at the S. end of Red Hill, in the shaly diabase, occurs an indurated rock (Sect. 633), agreeing closely in hand specimen and under the microscope with the rock N. of

the Felspar Porphyrite. The rock in the gully S. of Photo. Knob is a rather coarser type in which the fragmental character can be made out (Sect. 582), while the Knob itself represents coarse consolidated agglomerate, probably occupying the neck of a vent. This interpretation would remove the evidence of unconformable overlap of the Ordovicians N. of the felspar porphyrite claimed by Professor Gregory at this point. It is to be noted that the Felspar Porphyrite occupies a considerably smaller outcrop than is shown on the earlier map. West of the diabase and felspar porphyrite partially chertified Ordovician was seen at several points, but no good exposures were visible. The marginal Ordovician continues cherty to the gully south of the small Diorite Knob shown on the map. Here again I have altered the geological boundaries. The black cherts and very silicified rocks extend round the E. and S.E. sides of the diorite, and also in a somewhat less silicified form for about 20 yards on the west and south-west sides. A trench about 40 yards west of the diorite shows Ordovician shales, in places indurated and containing sporadic nodular lumps of cherty carbonates. The rocks here are vertical, and strike N. 40 deg. W. The same strike is noticed in a creek about 150 yards W. of diorite, and in much silicified shales 20 yards N.W. of the diorite, and also in the black cherts seen a few yards further north. Rock exposures are so limited that the relations between the black cherts and slightly cherty Ordovicians are not seen, but the evidence of dip and strike discloses no discontinuity. The black cherts extend much further to the N.W. than was shown on the earlier map, and have been traced beyond the next gully to the N., and then N.E. to within a few hundred yards S. of Crossing No. 45, where they come in contact with the granitic series. The marginal Ordovician continues to show evidence of silicification northerly as far as the gully at the S. end of Red Hill.

Between the diabase of Red Hill and the normal Ordovician occurs a narrow strip of rocks marked as metamorphic, and described as schistose beds by Prof. Gregory, which extend further both to S. and N. than is shown on the earlier map, and whose relations to both series are not very clear. At the S. end of Red Hill they are fragmental beds apparently made of diabasic material. A small gully running S.W. from here across the

strike of the beds gives an almost continuous exposure of these rocks, which pass into what is mapped as normal Ordovician. Strike and dip were observed at several points along the section, and were found to remain practically constant. The rocks plainly here form a continuous series without stratigraphical break, and the inference is that the schistose fragmental diabase rocks form the lowest representatives of the Ordovician series at this point (Plate XVII., Fig. 2). Following them northwards is a puckered shaly rock with surface outcrops of an alteration to ironstone, and to ferruginous cherts. At the beacon marking the summit of Red Hill the dump from an old mining shaft shows silky shales almost completely altered to chert. On the northern slopes of the hill not far north of the Beacon these give place to very decomposed, greasy-feeling shales, and N. and N.W. of these black cherts are again seen, and form the most northerly of these beds on Red Hill. West of Red Hill the ground slopes to a gully, and the very limited exposures do not permit a close examination of the relations of this series to the normal Ordovicians. Dips and strikes, however, in the two series, whenever they could be observed, were fairly concordant. At the S. end of the hill strikes E. and W. were noticed; further north both series showed W.N.W. strikes. No break in the succession was seen, and no conglomerates were noticed. The field evidence points strongly to the ironstones and grey and black cherts being simply highly altered representatives of the schistose fragmental diabasic bedded rocks at the S. end of Red Hill, and all these types should be included not with the pre-Ordovician, as Prof. Gregory maintains, but as the oldest representatives in this locality of the Ordovician series. Beyond the gully, running S.W. at the W. end of Red Hill, cherty Ordovician extends along the contact up to the small patch of Pliocene shown on the map. Beyond this the contact for about a mile has not been examined by me. A hill composed of black finely-bedded and folded cherts occurs about 250 yards W. of the Derrinal road, and about 300 yards N.W. of junction of the Derrinal and Murray roads. The hill is about 150 yards S. of crossing 51 on the railway. The dip is 90 deg., and strike W.S.W. It is shown on the early map as diabase, and it is indeed in contact with diabase. It appears at first sight to be a normal shale silicified

to a black chert. Closer investigation, however, showed that on the E. and N.E. sides, especially in a shallow railway cutting S. of Gate 51, less silicified portions of the same bedded series are represented, and pass gradually into a bedded fragmental diabasic rock, apparently a bedded diabase tuff. The evidence seems clear, then, that here the bedded black cherts, with associated ironstones, are simply silicified, probably submarine, basic tuffs, or rocks made up of diabase fragments. A few hundred yards beyond this hill the Ordovician diabase junction crosses the Derrinal road near a road cutting. The Ordovicians are soft brown shales containing numerous Magnesite concretions, strike N. 10 deg. W. about, and are nearly vertical. On the east side of the road cutting a few yards from the road, silicified shale was seen, and in the bed of the Mt. Ida Creek is an outcrop of a dense silicious rock, with Pyrite abundantly scattered through it. The rock looks at first like a quartzite, but under the microscope is clearly seen to be an igneous rock, consisting mainly of lath-shaped plagioclase, chloritised biotite and some Pyrite (Sec. 648). A few yards down stream the diabase was seen in situ, and is partly fragmental in character. Massive silicified diabase was seen a little N.E. of the road cutting, and again in a cliff section on the E. bank of the Mt. Ida Creek, north of the outcrop of silicious diabase. I have also examined the junction between diabase and Ordovician, at *several points further north*, notably W. and S.W. of the Selwynite outcrop, north of paddock A_6, Knowsley East, near the southern end of the Dinesus beds, in paddocks 3 and 3q, and also in paddocks 3m and 3j, Knowsley East. In all these places the Ordovician was more or less cherty in character, and in several places the Dinesus beds were distinctly cherty. Whatever explanation may be offered of this feature, Dr. Howitt's claim for the marginal alteration of the Ordovician near the diabase contact is one that can be generally substantiated in the field. It should be noticed that on Lidgey's may (Quarter Sheet No. 80), the diabase is not represented as outcropping anywhere in allotments 3q and 3m, Knowsley East, a gap of nearly a mile. In its place a thin outcrop of "Metamorphic" rocks is shown. Professor Gregory (op cit) refers to this locality as follows:—"Moreover the metamorphic rocks occur in places where there are no

igneous rocks exposed in the immediate vicinity. Thus an exposure of the typical cherts of the metamorphic series occurs along the eastern edge of allotment 3q in Knowsley East. The cherts occur between the Silurian rocks on one side, and unaltered Ordovician on the west. There are some diabases a little south of this allotment, but none occur in it." I am unable to reconcile the mapping and Professor Gregory's statements with my own observations at this point. At the S. end of allotment 3q, near the Murray road, is a limited outcrop of a bedded rock in hand specimen like a quartzite, and associated with it is a dark, dense cherty rock. Microscopic examination shows that the latter (Sect. 651) is a diabasic rock, probably fragmental, which has been almost completely silicified. I am less positive about the origin of the former (Sect. 588); it may be a quartzite, but it presents appearances which suggest that it may represent an extreme stage of replacement of a diabasic rock by silica. Just W. of this outcrop foliated or platy diabase occurs, similar to that on Red Hill, and, indeed, fragments occur fairly abundantly on the surface going northwards along allotment 3q, between the road and the outcrop of the Dinesus beds, which here, as elsewhere, are frequently chertified.

This evidence is of importance, as from the assumed absence of diabase in this locality, Professor Gregory inferred that the Ordovician overlaps and rests unconformably on the metamorphic cherty series.

An isolated area of diabase is shown on the map, occupying an allotment with the letters M of W, and indicated on the Parish Map of Knowsley East as Tranter's Paddock. It is represented as surrounded by normal Ordovician. It consists mainly of a platy variety of diabase similar to that on Red Hill, and probably representing an altered tuff. Near the margin it is highly silicified, and in places is converted into a black dense chert. The rock mapped as Ordovician, with which it comes in contact, is well bedded, generally considerably silicified, and cavernous, owing to the removal of crystals by solution from the rock. In general appearance under the microscope it strongly resembles a submarine bedded tuff.

An almost identical rock occurs just W. of S. Heathcote railway station, in what is mapped as Diabase; some of the

Dinesus material is also similar, and the cherts of Lady's Pass appear to differ from it only in a more complete silicification.

6.—Relations of the Dinesus Beds to the Ordovician and to the Diabase.

On Quarter Sheet 80 these beds are shown in the Parish of Knowsley East as a narrow band up to a quarter of a mile in breadth, stretching northwards from the northern end of allotment 3 to the middle of 3k. Their eastern boundary is the diabase series, and the bedded silicified fragmental diabase recorded as "Metamorphic." Their western boundary is with the Ordovician shales, and the boundary taken by Mr. Ferguson was a thin bed of a "brecciated-conglomerate." Along the road running west from the Murray road, and separating allotments 3m and 3j, a small section is to be seen in which the strike of the rocks is almost N. and S., and the dip about 70 deg. to the W. The section shows from E. to W. a few feet of the upper beds of the *Dinesus* series, consisting of brown shales and mudstones partially silicified. These are succeeded by the brecciated-conglomerate about 2 inches in thickness, consisting of subangular fragments of shaly material, and cherty fragments set in a fine groundmass. Succeeding these are mudstones with smaller fragments forming, according to Mr. Ferguson, the lowest beds of the normal Ordovician series here. A specimen taken about 20 feet W. of the brecciated-conglomerate consists of a bedded, rather dense, light-coloured, somewhat cherty rock containing little black specks, which were at first thought to be small fragments of an older black chert. Under the microscope, however (Sec. 634) (Pl. XVI., Fig. 4), these show as quite colourless areas, with no defined boundary, but passing gradually into the groundmass of the rock. There can be no doubt that they are secondary in origin, and represent local segregations of chalcedonic silica in a less siliceous matrix.

The brecciated-conglomerate also contains fragments of what in the hand specimen look like a black chert. Under the microscope (Sec. 618) (Pl. XIV., Fig. 1), it is seen to consist of fragments of altered diabase, and of a fine-grained rock, possibly diabase tuff. All of the fragments are more or less silicified,

but the bedded fragments are more completely replaced than the others, and some approach in character the black cherts. Secondary quartz as well as chalcedony occurs, and it is probable that all the silicification was effected after the formation of the conglomerate. In one fragment a circular cross-section in chalcedony may represent a section of an organism. From the appearance of the rock under the microscope, it may be either a local shoreline detrital conglomerate, or a rather coarse submarine tuff. In any case it is clearly interbedded, and cannot be regarded as representing a stratigraphical break between two separate formations.

The relations of the *Dinesus* Beds to the Diabase have not been clearly seen. The diabase for at any rate some distance along its outcrop east of the *Dinesus* Beds is either the platy type as occurs at Red Hill, or the highly silicified jasperoid, and I have not anywhere seen an exposure showing the relation of the two series. The abrupt junction shown on the Quarter Sheet between the two at the S. end of the *Dinesus* Beds I have been unable to confirm. Cherty tuff-like rock fragments occur in the paddock both to the N. and S. of the junction, as mapped, but no exposures are seen. The field and microscopic evidence would admit of two explanations. On the one hand the diabase may be an older series and the *Dinesus* beds may represent bedded detrital rocks from the old diabase land area. On the other hand, the diabase may be practically contemporaneous and represent submarine lavas and tuffs passing westward into more finely-bedded tuffs, the *Dinesus* series.

7.—Nature and Origin of the Igneous Rocks.

The Basic Igneous Series.—As pointed out by previous workers, the basic igneous rocks comprise intrusive masses, lava flows, and fragmental (pyroclastic rocks).

Dr. Howitt and Professor Gregory maintain that most of the rocks are intrusive, while Mr. Dunn, from field evidence, regarded them as mainly surface rocks. Within the limits of the area I have observed—viz., from Photograph Knob on the south, to Lady's Pass on the north—I find both field evidence and microscopic evidence in support of the view that the bulk of the rocks consist of lavas, tuffs and agglomerates, and that intrusive

rocks are rather sparingly represented. Dr. Howitt has discussed so fully most of the characters of the igneous rocks that it is not necessary to do more than refer briefly to them, except the more altered rocks, in relation to the question of the origin of the silicification of the Heathcote rocks.

Intrusive Rocks.—Dr. Howitt has described some of the diabases as intrusive rocks, and among the small intrusions in the form of bosses are the Diorite Knob at S. Heathcote, and another similar mass just west of S. Heathcote station. Another rock from about ⅓ mile N. of the Selwynite outcrop, which I have examined (No. 630), is holocrystalline, and is clearly an intrusive diabase. They show distinct petrological characters from the diabase series, as Dr. Howitt has pointed out, yet they are almost certainly genetically related to the diabase magma, and represent rather later and somewhat less basic intrusions of the magma.

Basic Lavas.—Rocks of this character appear to be sparsely represented in the southern part of the area examined, but have been met with in several areas between the Selwynite outcrop and Lady's Pass. Some of the diabase rocks just south of Lady's Pass appear to be lavas, and two other rocks may be specifically referred to.

Opposite the Junction Hotel, about a mile S. of Lady's Pass, is a massive outcrop of a compact diabase. Under the microscope (Section 601) the rock is seen to be distinctly porphyritic, comparatively fresh phenocrysts of plagioclase, and chloritised pseudomorphs after hornblende or augite are set in a fine felted groundmass, which has been recrystallised as a mixture of needle-shaped actinolites and a colourless base, possibly felspar and quartz. Associated with the chloritic pseudomorphs are secondary crystals of epidote. In its altered condition the precise nature of the rock is difficult to determine; it might be an intrusive or an effusive rock. From its field characters I am inclined to regard it as a porphyritic lava. Another rock of less equivocal character was examined in a paddock about 300 yards W. of the Murray road, and about 1½m N. of the Selwynite outcrop, in allotment A6, Knowsley East. The diabase rocks here form a ridge, and are considerably altered to siliceous and calcareous diabases.

A rock section (No. 602) shows that no original minerals remain, the rock now consisting of chlorite, carbonates, chalcedony, secondary quartz and secondary albite. Some of the original structures remain, however, and the presence of amygdaloidal cavities filled with secondary minerals is noticeable, not only in the rock section, but abundantly in the field, and demonstrates that the rock was originally a vesicular lava flow.

Pyroclastic Rocks.—Fragmental igneous rocks in my opinion represent the predominant type in the area I have examined. They include agglomerates, tuffs and other altered rocks, originally composed mainly, if not entirely, of diabasic fragments which may be tuffs or detrital sediments. The latter are generally well bedded, and usually more or less completely altered to cherts.

Agglomerates.—The best example of these occurs at Photograph Knob, in S. Heathcote. A small eminence here marks the position of the plug of an old volcanic rent, in and near which the coarser diabase fragments fell. Subsequent alteration has converted the mass into a very tough, hard rock. The agglomerate, from its relation to finer tuffs exposed in a stream bed to the S., and also seen to the north, appears to be rather younger than and intrusive into them. My interpretation of relations of the rocks near here is shown in the accompanying sketch section (Pl. XVII., Fig. 1). Under the microscope (No. 545) (Pl. XIV., Fig. 2) the agglomerate consists of angular fragments of a dark basaltic rock with lath-shaped felspars in a groundmass of a more felspathic recrystallised diabase, possibly originally fragmental. It consists now entirely of secondary minerals, including felspars, quartz and needle-shaped actinolite. Vivid green chlorite fills cavities in the rocks, and also replaces primary minerals, probably felspar and augite. The large size of some of the rock fragments gives the rock the character of a typical agglomerate.

Another rock (No. 576) (Pl. XIV., Fig. 3) occurring as boulders in the foliated diabase of Red Hill, near the junction with the granitic rock, is also coarsely fragmental in character. Under the microscope some of the fragments are seen to be similar to the platy diabase. They are set in a dense groundmass whose character is obscured by alteration, and the boundaries of the fragments are defined by a red-brown ferruginous layer.

Tuffs.—Under this description I place the platy diabase of Red Hill, described by Dr. Howitt as a sheared diabase, and similar rocks near Photograph Knob, just south of the cherts of Lady's Pass, below the cutting in Ordovician on the Derrinal road about ⅓ mile N. of the Murray road junction, the diabase from allotment 3q, Knowsley East, and from the isolated diabase mass in E. Tranter's allotment M. of W., Knowsley East. Some of the highly altered diabase rocks to be described later are also quite possibly fragmental in origin. Owing to the alteration and foliation of these rocks, in no case is the characteristic structure of the groundmass of a normal tuff preserved. Both in the diabase of Red Hill and in the rock in the gully S. of Photograph Knob the fragmental character can be seen in the field, and in hand specimens, and a passage from these into finer-grained rocks, presumably volcanic ashes, is to be observed. The inclusion of coarser types like the agglomerate (No. 576), described above in the finer platy diabase of Red Hill, is significant, and is of assistance in determining the original character of these altered rocks. The rock from the stream bed S. of Photograph Knob shows in section (No. 582) parallel development of chlorite and secondary quartz and felspars, and some magnitite. Irregular lighter coloured areas may represent fragments of a rock of different character. The dense, fine-grained diabasic rocks from the paddock ¼ mile S. of Photograph Knob (No. 597), and from the area previously mapped as Ordovician, just N. of the felspar porphyrite (No. 614), have been previously referred to, and their resemblance to a fine indurated bluish diabase at the S. end of Red Hill (No. 633). From their association with rocks whose fragmental character is clearly visible, I regard these types as probably volcanic ashes, which by alteration and subsequent pressure have been indurated and have developed a marked foliation. Their character is in striking contrast to the diabases which can be shown to have been lava flows and intrusions, and which appear to have undergone the same mineralogical changes as the foliated diabases.

A rock whose fragmental character is clearly manifest (No. 583) (Pl. XIV., Fig. 4) is the type represented in allotment 3q, Knowsley East, where, according to the Quarter Sheet and to Prof. Gregory, no diabase occurs. Under the microscope the rock is

seen to be composed of larger and smaller angular fragments of diabase altered to a chloritic rock. Many fragments by the introduction of silica in solution have been converted into cherty rocks. The process of partial silicification has in the case of this rock not been attended by the removal from the rock of its original felspathic material. This has recrystallised as secondary felspars, and with them occur secondary quartz crystals. Irregular chalcedonic areas are also to be seen, and small quartz veins. The secondary character of both the quartz and felspar is indicated in places by the fact that the replacement of the original diabase has been only partially effected, so that the secondary mineral has included some of the diabasic material.

Flanking the foliated diabase of Tranter's paddock, M. of W., Knowsley East, there is a bedded silicified rock mapped as Ordovician. It occurs between the platy diabase and the Ordovician shales, but its relations with each are not clear, as no exposures are visible. Its bedded character tends to link it with the sedimentary series, but its mineralogical constitution shows its relationship to the diabase series. The hand specimen has a pitted surface, due to the solution and removal of minerals. The shapes of the cavities are of two kinds, the one elongated prismatic, suggesting the former presence of actinolite, the other clearly having the shape of felspar crystals. Under the microscope (No. 584) (Pl. XV., Fig. 1) the bedded and cavernous characters are visible. Numerous altered crystals of pyroxene and larger fragments of igneous rocks are set in a fine textured groundmass, which is now silicified. The rock appears to have been a bedded submarine tuff, or possibly a clastic rock derived from a diabase shore line. A precisely similar rock occurs flanking the diabase just W. of the S. Heathcote railway station, and some of the rocks in the area mapped as *Dinesus* Beds are similar in character, and generally more or less silicified. Under the description of the black cherts I shall have to point out similarities which exist between many of them and rocks of this character.

The Granitic Rocks.—Dr. Howitt has given full petrological descriptions of these rocks. One type he refers with some hesitation to aplite, and notes that it is frequently granophyric, and the other he refers to as labrador-porphyrite.

Professor Gregory agreed with Dr. Howitt in the naming of the porphyrite, but regards fine-grained grano-diorite as being a more suitable term for the rock which Dr. Howitt has referred to the aplites.

I can appreciate the difficulty in finding an appropriate name for this type, and I think this difficulty is connected with its mode of origin. The minerals present are plagioclase (oligoclase to labradorite), hornblende, biotite, a white mica, quartz and orthoclase in the rock (No. 627) from just S.W. of Gate 45, S. Heathcote, while in the Red Hill exposure very little hornblende or biotite occurs (No. 587), but the rock is more altered, and they may have been removed by solution. I think that perhaps the term micro-granite, using it in a wide sense, would be an appropriate name for most of the occurrences, while many of the rocks show so marked a granophyric or micrographic intergrowth of quartz and orthoclase that the term granophyre may be used to define these varieties.

The origin and relations of these rocks merit some consideration. They are certainly not normal plutonic rocks. The fine-grained character and other peculiarities show that the magma consolidated under a comparatively small thickness of rock, and its mineral composition and the micrographic and granophyric intergrowth of the quartz and orthoclase suggest that it represents a residual relatively acid, part of a basic magma, and having more or less the composition of an eutectic mixture it remained molten after the intrusion and consolidation of the more basic part of the magma. I regard these micro-granites and granophyres and the labrador porphyrite as genetically related to the diabases, belonging to the same volcanic period, and representing the last of a series of intrusions, of which the diorites mark an earlier phase.

The microgranite in places comes into relation with the Ordovician series, although no good contact has been observed. Of course, if the granite were the older series no contact metamorphism should be seen. Even if the granite were intrusive into the Ordovician the amount of alteration to be expected at the juncton would, I think, be very small in view of the probable relatively superficial conditions and low temperature of its consolidation. The contact of diabase and micro-granite is well exposed

on Red Hill, and here the alteration effected by the granitic intrusion is certainly trivial, amounting only to a slight bleaching in colour, and the production of a rather fissile-jointed character in the diabase for a distance of about three feet from the contact. The labradorite-porphyrite occurs as a small intrusion in the diabase, just north of Photograph Knob, and as a marginal rock at the junction of the micro-granite and diabase at Red Hill. It is a dark rock (No. 599) with porphyritic labradorite, biotite and hornblende, in a dense granophyric groundmass of quartz and orthoclase. It must be regarded as a modification of the micro-granite which may possibly have absorbed some diabasic material before consolidation.

8.—Nature and Origin of the Ordovician Sediments.

This question has been discussed in considering the relation of the Ordovician and cherty series to the diabases, and the appearances of Ordovician shales in hand specimens, and under the microscope have been compared with those of fine-grained diabase rocks. It has been shown that at the S. end of Red Hill a continuous conformable succession is seen from a rock composed of diabase fragments, through finer-grained types to the normal Ordovician shales. The evidence points strongly to the Ordovician series, near the diabase, being composed mainly of diabase fragments. This is supported by the observation, first made by Mr. Dunn, which can be verified at several localities, that magnesite nodules segregate from the Ordovician shales. The junction between the foliated diabase of Red Hill and the diabasic Ordovician is a sharp one (Pl. XVII., Fig. 2). It may be explained either as an unconformable junction or as a fault junction. In the first case the diabase might be pre-Ordovician, in the latter the diabase may be of Lower Ordovician age, and consist of unbedded tuffs passing into a bedded series.

The *Dinesus* beds, which also are mainly composed of diabase fragments, appear to be interbedded submarine tuffs; they may possibly be, however, detrital sediments formed from a pre-Ordovician diabase. No section showing the relations of the two rocks has been observed.

9.—Altered Rocks.

A.—*The Age and Origin of the Cherts.*

The lighter, less silicified rocks seen in many places near the contact of diabase and Ordovician present few difficulties, as they are clearly only moderately altered shales of the Ordovician series.

A peculiar type of more silicified bedded rocks occurs flanking the isolated diabase of Tranter's paddock, Knowsley East. Another outcrop occurs W. of S. Heathcote railway station, and is also represented among the rocks mapped as *Dinesus* Beds. The S. Heathcote occurrence is mapped with the diabase, the one flanking the isolated diabase is mapped as Ordovician. There can be no doubt that all the occurrences represent the same type, while the cherts of Lady's Pass appear to differ only in more complete silicification. Their characters can be studied from a section (No. 584) (Plate XV., Fig. 1) of a rock from the flanks of the isolated diabase outcrop, Knowsley East. The rock is bedded and cavernous, and some of the cavities have the shape of felspar crystals, others more elongated suggest actinolite. The bedding is only slightly defined in the section. Numerous altered crystals of pyroxene occur, and larger fragments of igneous rocks lie in a fine-textured groundmass now silicified. The rock has all the appearance of a silicified submarine tuff.

In the case of the Black Cherts the problem is more complicated, owing to the complete mineralogical change which most of the rocks have undergone. A rather special type of black chert occurs at the margin of the foliated diabase in Tranter's paddock, Knowsley East. It is dense, dark in colour, and not well bedded, but less altered stages occur with it, and show a passage into diabase.

The more normal well-bedded type of black cherts occurs, among other places, at the N. end of Red Hill, near Gate 47, on the railway line south of the station, near and N.W. of Diorite Knob, near Lady's Pass in Dargile, and at a hill just south-west of Gate 51 on the railway north of the railway station.

The cherts near Gate 47 junction with the micro-granite, and with the alluvium, so that their relations with the diabase and

the Ordovicians cannot be made out in the field. Under the microscope (No. 612) (Pl. XV., Fig. 2) the bedding planes, defined in the hand specimen by red band, are seen to consist of iron-stained fragments, some of which can be seen to be igneous. The bulk of the rock has been silicified, and in it occur minute rods which may be volcanic glass. Some colourless circular chalcedonic areas may be secondary segregation of silica, but their definite outlines suggest that they are probably organic. The rock appears to have been originally a submarine bedded tuff, or a detrital rock formed from igneous material. The bedded cherts of Lady's Pass are surrounded by members of the diabase series, some of which are foliated tuffs. The cherts are continuous in strike with the foliation of the tuffs, and the former presence of crystals in the rocks is indicated by the shapes of the hollows left after their removal. Less silicified forms were seen, which approached in character a diabase tuff, and, no doubt, that was their original character. Their relations to the Ordovician rocks, of course, cannot be made out in the field.

The cherts of the hill south-west of Railway Gate 51 occur between Ordovician shales to the W. and diabase to the eastwards; but no section showing their relations is to be seen. In places they pass from black bedded and folded cherts into ironstones, and to the east in the shallow railway cutting they can be seen to pass into fragmental diabase. One of the less cherty types (No. 631) shows in section under a high power (1-9in.) a chalcedonic matrix, and scattered through it are actinolite needles, small rounded shapes, possibly Radiolaria and larger irregular clear cellular masses having a different refractive index from the matrix, which are almost isotropic. They are probably fragments of cellular volcanic glass, and the rock is a fine basic volcanic ash in which the minutely fragmental groundmass has been silicified.

The best field evidence showing the relations of the black cherts to the Ordovician series is to be seen near Diorite Knob, S. Heathcote, and at Red Hill. In both localities dips and strikes of the black cherts agree almost precisely with those of the Ordovicians, and less cherty types occur between the two series. Furthermore, no sign of conglomerates containing chert fragments occur between the two. The presence of chert

fragments in the Silurian conglomerates constitutes the best evidence that the cherts are pre-Silurian. The total absence of conglomerates at the junction of the cherts and Ordovician shales is strong negative evidence that there is no stratigraphical break between them, that is, that the cherts are not pre-Ordovician. The field evidence strongly points to the black cherts representing highly silicified Ordovician tuffs or fine-grained bedded fragmental rocks made up of diabasic material. The mineralogical and petrological similarity of the black cherts from near Gate 47, and from the Lady's Pass, is so close that there can be little doubt that they also are altered Ordovician rocks, although they do not come into relation at the surface with normal Ordovician rocks.

Specimens of banded black chert (Nobby's chert) obtained by me when visiting Newcastle, N.S.W., in company with Prof. David, are almost indistinguishable from some of the Heathcote cherts. It is interesting to find that Prof. David[1] has obtained clear evidence in the field, and Mr. Card in microscopic sections, that this chert is a silicified bedded tuff. Its very close resemblance to some of the Heathcote cherts suggests, therefore, a similarity of origin for the latter.

Origin of the Silicification.—Dr. Howitt has claimed that the silicification of the Ordovicians represents the direct effects of contact metamorphism due to the intrusion of the diabase into the Ordovician. Prof. Gregory, on the other hand, maintains that the cherts represent the oldest rocks in the district, and were formed in pre-Ordovician times, and that the diabase was subsequently intruded into them. According to him, then, the cherts are not in any way genetically related to the diabase, but he does not discuss at all the question of how they were formed.

Dr. Howitt has shown that in some places as you recede from the diabase the silicification is less intense. The change is, however, not always so gradual.

I am unable to agree with Dr. Howitt that the silicification is due to contact metamorphism by the intrusion of diabase. The change does not consist in a production of new minerals by

1 "The Geology of the Hunter River Coal Measures." Memoirs of Geol. Surv. of N.S.W., Geology, No. 4, Part I., p. 17.

recrystallization of material already present in a rock, which is the normal effect produced in a sediment by an igneous intrusion. The ordinary minerals produced by contact metamorphism are quite unrepresented. In place of this there has been a fundamental change in the chemical composition of the rock. The original diabasic constituents—lime, magnesia and iron—have been more or less completely removed, and replaced by chalcedonic silica. It seems to me quite improbable that a magma of the composition of diabase should be capable of supplying to an invaded rock silica in such large quantities. This view, moreover, can only be maintained on the hypothesis that the diabase is intrusive. I have stated above my reasons for regarding the bulk of the diabase as consisting of lavas and pyroclastic rocks, and the cherts as being probably silicified bedded submarine diabase tuffs, or at any rate fragmental diabase rocks. On this view the diabase may be older than the cherts, but is more probably practically contemporaneous with them, and therefore cannot be regarded as the direct agent of chemical change.

The explanation which I offer of the production of the cherts and cherty rocks is that they are the result of metasomatic, replacement in certain parts of the Ordovicians by silica-bearing solutions traversing the rocks subsequent to the formation of the diabase and the Ordovicians in contact with it. This view receives confirmation from the fact that the diabase, like the Ordovicians, is locally silicified, and in places almost completely replaced by silica, as will be described below. This circumstance makes it improbable that the diabase, which is itself silicified, can be the direct cause of silicification of the cherty rocks.

The limitation of the silicification to those rocks near the junction with the diabase is a noteworthy feature, and must, I think, be discussed in connection with the original composition of these rocks. These I have shown to be mainly composed of fragmental diabasic material near the diabase, and as you go westwards from the diabase junction you pass into higher beds in the series, which gradually take on the characters of normal shales. I think, then, that solutions carrying silica traversed diabase and Ordovician alike, and that selective silicification took place; some of the diabases, and the Ordovicians which

were composed of diabase fragments, were of such composition and character that chemical interchange most readily took place, resulting in the formation of various kinds of silicious diabase, and of the different types of cherts associated with the sediments. Even in these rocks of basic composition the replacement has taken place in varying amounts in different places, and this may possibly be due to differences in chemical composition or to physical differences in different parts of the series, such as original differences in texture or in the porosity of the rock through which the solutions passed.

Evidence from Tatong and Lancefield Areas.—The selective character of the silicification is perhaps more strikingly illustrated from other areas. Mr. Summers (op. cit.) has shown that near Tatong cherts are interbedded with normal sediments. A visit which I recently made to the Mt. William and Lancefield districts provides another illustration. In the quarry from which the typical Lower Ordovician Lancefield graptolites have been obtained, unaltered graptolite bearing shales are clearly interbedded with silicified shales containing graptolites, and with dense cherts in which no organisms are visible. In both these cases it seems to me to be clear that the alteration of the rocks cannot be due to contact metamorphism by diabase intrusions, for some of the shales are quite unaltered. The selective silicification must, I think, be connected with original chemical and physical conditions in the beds themselves.

The only evidence I have seen in the field of typical contact alteration of the Ordovician rocks near the diabase series is at Mt. William, a short distance from Mr. Donaldson's house, and I am indebted to that gentleman for showing me the principal rock outcrops. Near here, besides the Ordovician rocks there occur a dense diabase, a granite porphyry intrusive into the diabase, and an outcrop of a coarse-grained granitic rock which is an extension of the granitic rock of the Cobaw Ranges. The granite-porphyry is intrusive into the diabase as the micro-granite of Heathcote is intrusive into the diabase there. I think it has probably orginated in the same way as a residual more acid part of the diabase magma. It has caused little or no visible alteration in the diabase, and is probably of comparatively superficial origin. The coarse-grained granitic rock,

on the other hand, is typically plutonic in aspect, being coarsely crystalline and porphyritic. It is connected with the Cobaw massif which has metamorphosed the Ordovicians in contact with it. The Ordovician shales near here are in places altered to Chiastolite slate, and there can be little doubt but that the coarse-grained granitic rock is responsible for the alteration, and not the diabase or the later granite-porphyry.

B. *Abnormal Features of the Diabase Series.*

(*a*) *Silicification.*—The diabase of Tranter's paddock, Knowsley East, is in places changed to a dark, dense silicious rock, somewhat resembling the black cherts, but showing no bedding planes.

South of the Gully at the south end of Red Hill there is a southerly continuation of the foliated diabases, which here have undergone remarkable chemical replacement. The rock presents various stages in silicification, and in places solutions have removed practically all the diabasic material, and there now remains a very cavernous rock, consisting mainly of well-shaped small quartz crystals.

Production of the Jasperoids.—The most interesting and remarkable of the metasomatic changes is that to which the formation of the red jasperoids is due. No discussion as to the origin of these jasperoids has yet appeared. Dr. Howitt and Professor Gregory and Mr. Lidgey refer to them as metamorphic, and in a recent note (op. cit.) Mr. Dunn has described their northward extension near Tooleen, where, he says, "they are associated with an ancient igneous rock."

Jaspers appear always to be formed by metasomatic replacement of certain rocks by silica, with the separation of some oxide of iron. Red jaspers are associated with the ironstone of Nowa Nowa, at the head of Lake Tyers, but in this case they can be clearly seen to arise from the alteration of ancient, highly folded sandstones. The jasperoids of Heathcote, however, are derived from the diabase. The clearest evidence of their mode of origin can be seen in a limited exposure of massive diabase, about 40 yards west of the Murray-road, and about 300 yards south of the selwynite outcrop. Here, within a few feet, all

stages can be traced between a compact diabase through stages more and more silicious to a bright red jasperoid. The jasperoid here is of quite limited occurrence, and passes outwards in all directions into the dark, dense diabase. Silica-bearing solutions appear to have traversed the rock along some joint or fracture plane, and have altered the rock for a foot or two from a central point. The jasperoid is itself traversed by later formed white quartz veins.

Under the microscope (No. 549) (Pl. XV., Fig. 3) the original structure and minerals of the diabase have been completely lost. The rock now consists of a chalcedonic replacement, stained red by hematite, probably derived from iron containing minerals in the original diabase. The deposition of the iron-oxides has been irregular, darker and opaque areas passing across the section in bands. The chalcedony has crystallised from centres in radiating groups of crystals. Their boundaries are defined in the rock section by colourless lines of secondary silica. In polarised light these radiating aggregates show irregular black crosses.

In allotments 3q and 3m, Knowsley East, a thin strip of metamorphic is shown on the map, while the diabase is not represented. I have shown above that foliated diabase actually occurs, and some at least of the outcrop of "Metamorphic" is in reality jasperised diabase.

In the Heathcote district it is safe to regard the jasperoid, wherever found, as being one of the forms of silicified diabase.

Calcareo-siliceous Rocks.—A strip of very altered rocks occurs in South Heathcote, extending to the N.W. from just north of the South Heathcote Hotel, crossing the main road, and terminating against the micro-granite near the railway cutting at the back of the Ben Nevis Hotel. Its character varies from place to place. At one spot it is almost a carbonate rock, in another almost a chert, and greenish patches, sporadically developed, resemble selwynite in colour, being probably due to the separation of oxide of chromium. It was originally a diabase rock. A section taken from an outcrop 200 yards N.W. of the S. Heathcote Hotel will serve to illustrate some of the characters of the rock. Under the microscope (No. 592) (Pl. XV., Fig. 4) one can trace two stages in the alteration of the original rock. It was first

converted into a ferruginous carbonate rock by decomposition of the original silicate by carbonated water. Crystallization of the carbonates proceeded from isolated centres, and eventually became confluent. Later silica-bearing solutions have replaced a good deal of the carbonates by chalcedonic silica, but the original boundaries of the carbonate areas are still traceable in the cherty areas by fine dusty inclusions.

The exact nature of the carbonates cannot be determined under the microscope, but they probably consist of a mixture of lime, magnesia and ferrous carbonates, the latter by subsequent partial oxidation have imparted a red-brown colour to the mass.

On the W. bank of the McIvor Creek, about 200 yards N.W. of this point, there is an exposure of the bedded chert series. The relations of this to the calcareo-siliceous diabase rock cannot be clearly made out.

(*b*) *Corundum in the Diabase.*—Close to the jasperoid, 300 yards south of the selwynite outcrop, is a small gully, and in it I found a mass of a heavy, purple and green coloured rock, which was found to consist of a mixture of corundum and a green micaceous mineral. The specimen was not in situ, but could not have rolled far, as the gully terminated about 100 yards north of where it was found.

On examining the workings at the selwynite outcrop, Mr. Summers found a second lump of the same rock associated with the selwynite. A section from the first specimen (No. 550) (Pl. XVI., Fig. 1) shows prismatic, pink, highly refractory needles and irregular masses of corundum. They are noticeably pleochroic, and have polarization colours about the same as those of quartz. Stouter prisms, probably of a pale orthochrombic pyroxene, showing good prismatic cleavage, generally straight extinction and bright polarization colours of the second order, also occur. The background is composed of a very pale green to colourless micaceous mineral, probably chromiferous. Red brown to opaque grains of chromite are also sparsely scattered through the rock slice.

On examining sections cut from the siliceous diabase which passes into jasperoid at the outcrop, 300 yards south of the selwynite, evidence was obtained that the corundum occurred in situ in the diabase. Under the microscope (No. 551) (Pl. XVI.,

Fig. 2) it is seen that the original texture of the diabase is almost completely lost owing to secondary silicification. In one place, however, an original vesicular structure is still visible. The secondary silica occurs both as allotriomorphic quartz crystals, but mainly in the form of radial chalcedonic aggregates. In ordinary light dots of opaque iron oxide separate the radiating fibres, and in polarised light the fibres give a black cross. Scattered through the rock are long prisms with hexagonal cross sections, which have precisely the habit of the corundum previously described. The corundum has, however, been almost entirely replaced by secondary minerals, including opaque oxide of iron, chalcedony, chlorite and carbonates. This is only the second record of corundum in Victoria, apart from its occurrence in the deep leads and alluvial deposits. The first occurrence was noted last year in association with the serpentine of the Mt. Wellington district, in Gippsland. This occurrence has been described by Mr. Dunn[1] and by Mr. Thiele.[2] The corundum occurs as blocks on the surface of the serpentine, and may be "in situ," but this cannot be proved.

This occurrence of corundum at Heathcote appears to be the first in Victoria in which it has been traced to its parent rock. Its crystallization evidently took place from a part of the diabase magma, not only locally rich in alumina, but also in chromium, and it may represent a local segregation from the normal diabase.

(*c*) *The Selwynite and its Origin.*—This substance, described as a mineral, was first referred to in the Exhibition Essay for 1867. It was more fully dealt with by Ulrich.[1] Four quantitative analyses were made by Cosmo Newbery, and one is here recorded.

SiO_2 - - - -	47.15
Al_2O_3 - - - -	33.23
Cr_2O_3 - - - -	7.61
MgO - - - -	4.56
Na_2O - - - -	
H_2O - - - -	6.23
Total -	98.78

1 'Mining Standard," Oct. 16th, 1907.
2 Proc. Roy. Soc. Victoria (this volume).
3 Contributions to the Mineralogy of Victoria, 1870, pp. 21-25.

Traversing the green "selwynite" are veins of an almost colourless micaceous mineral, described by Ulrich as "talcosite." An analysis by Newbery gave the following results:—

SiO_2 - - - -	49.01
Al_2O_3 - - - -	45.1
Cr_2O_3 - - - -	tr
FeO - - - -	tr
MgO - - - -	tr
H_2O - - - -	4.98
Total -	99.09

It has been recognised for many years that the substance, "selwynite," is not a true mineral species, but a mixture, and is, in fact, a rock. Microscopic examination of a thin section of the substance (No. 566) (Plate XVI., Fig. 3) confirms this view, and shows that at least four minerals are present. The groundmass forming the bulk of the rock is a mineral which is probably chrome-bearing, and imparts the green colour to the rock in the hand-specimen. It occurs as a granular or scaly meshwork of microscopic colourless crystals, polarizing in neutral tints as an aggregate. Scattered through this background are a few opaque grains, probably chromite, and many larger granular crystals of a mineral showing rather high refraction, purplish-brown colour and polarization colours of the second order similar to augite. The mineral is slightly pleochroic, and may be an altered orthorhombic pyroxene. The remaining mineral, the so-called "talcosite," occurs in a vein through the rock, and consists of radiating and parallel prismatic crystals of a colourless to pale-green micaceous mineral showing high polarization colours.

Corundum, while not identified with certainty in section, occurs with the selwynite in the outcrop by the Murray road, as mentioned above.

The selwynite outcrop, while near the junction of diabase and Silurian on the surface, is certainly within the diabase boundary, and there can be little doubt but that it represents one type of alteration of a diabase rock formed from a magma locally rich in chromium and aluminium oxides. Solutions passing through this rock have leached from it most of the lime and magnesia, and have introduced water, leaving a rock con-

sisting chemically of silicate of alumina, water and oxides of chromium and aluminium.

10.—The Age of the Rocks of Heathcote.

(*a*) *Fossils of the Dinesus Beds.*—The evidence for the age of these rocks rests on a few fragments of trilobite, some badly preserved brachiopod fragments, and some obscure markings, thought at first to be graptolites of the *Bryograptus* type, but later regarded as probably algal in character. These latter and the brachiopods afford little help in determining the age of the rocks. The trilobites, according to Mr. Etheridge, junr. (op. cit.), have Cambrian affinities. Professor Gregory, with more material to work on, regards the fragments as containing two genera, both new, and on the whole probably of Lower Ordovician age. In rock sections of some of the *Dinesus* beds I have noticed some minute circular chalcedonic areas, some apparently tubular, which may be cross sections of sponge spicules, but no definite structure can be made out. Other areas suggest the possibility that Radiolaria may be present.

From a locality near the junction of Dinesus beds and the normal Ordovician I found on splitting open some shales several casts of large spicules intersecting at right angles, characteristic of *Protospongia* a form which in Britain I believe is only found in Cambrian rocks. In view of the occurrence of Bryograptus in Victoria associated with Lower Ordovician forms, not much weight can, I think, attach to the occurrence of these sponge spicules in the *Dinesus* beds. Their presence probably would not necessitate placing the rocks with the Cambrian series if the evidence of the trilobites points to the Lower Ordovician age of the rocks.

(*b*) *Fossils of the Ordovician Rocks.*—I have above stated my reasons for dissenting from the separation of the beds containing the *Dinesus* fauna from the beds which succeed them, and which have been, on lithological grounds, regarded as Ordovician. Sections were made from a rock (No. 634) (Pl. XVI., Fig. 4) occurring in the Ordovicians 20 feet west of the outcrop of the brecciated conglomerate on the road running W. from the Murray road towards the diabase of Tranter's paddock. Under the micro-

scope the rock is seen to be more or less chertified, and to contain numerous longitudinal and transverse sections of a tubular organism, some of which are branched. The cross-sections are circular, and show a central cavity now filled with chalcedony. I am unable to determine the nature of these organisms. Small circular bodies in the rock are suggestive of the former presence of Radiolaria.

Another section cut from the same rock shows some triradiate spicules, and other four rayed spicules intersecting at right angles, which are referable to *Protospongia*. This is the first record of fossils from the normal Ordovician rocks near Heathcote, but their evidence does not help much in fixing the age of the series. Small circular areas similar to those described above are seen in sections of some of the cherty shales of the *Dinesus* rocks, and are also recognisable sometimes in an iron-stained condition in some of the black cherts, as for instance those near Gate 47, south of the Heathcote Railway Station. It is possible that they may be inorganic segregations of chalcedony, but their defined boundaries and occasionally the suggestion of an inner wall suggest an organic origin, and I have doubtfully compared them to Radiolaria, whose structure has been destroyed by secondary silicification. It will be seen that the palaeontological evidence from these rocks is still inconclusive, and it seems to me to be safer to continue to regard them as of Lower Ordovician age until better evidence is forthcoming.

(*c*) *The Age of the Black Cherts.*—I have shown above that these rocks were composed mainly of diabase fragments, and that their peculiar composition led to their almost complete silicification. Their general agreement in dip and strike with the Ordovicians, and the complete absence of conglomerates containing chert fragments between them and the Ordovicians, points to their being the lowest part of the bedded Ordovician exposed to view. At Lancefield, where cherts occur not only between the diabase and the fossiliferous Ordovician, but also interbedded with graptolite-bearing shales, their Lower Ordovician age is clearly demonstrated.

(*d*) *The Age of the Diabase and other Igneous Rocks.*—The field and microscopic evidence is not so complete as to fix

with certainty the age of the igneous rocks and their relations to the bedded series. The sharp break between the foliated diabase at the south end of Red Hill and the diabasic fragmental rocks which pass upward into normal Ordovician shales, may be interpreted as an unconformable junction of an older series, the diabase, with a younger one largely composed of detritus from it. Even granting the unconformity, the relations might be explained if Lower Ordovician submarine volcanic tuffs were piled up so that at this place they became sub-aerial and with further eruptions part of the material was deposited on land and part falling into the sea near the shore line, became more bedded. Subsequent lateral pressure would impart foliation to the subaerial series and tilt the submarine series at a high angle. The strike of the foliation of the diabase differs from that of the bedded series, but both dip at almost the same angle, 70 deg.-80 deg.

An alternative, and, I think, on the whole a more probable explanation, is that the junction between the two rocks at this place is a fault junction. The line of junction runs northerly from here in almost a straight line, and it seems probable that the beds to the west have been let down, and discontinuity produced in what was formerly a continuous series.

Evidence from the northern part of the district rather supports this hypothesis, for the *Dinesus* Beds and also the black cherts (making allowances for subsequent alteration) have a strong resemblance to submarine bedded tuffs passing upwards on the cessation of volcanic activity into more normal sediments. The bosses of diabase, diorite, felspar-porphyrite and micro-granite are somewhat later intrusions from the diabase magma, and in most cases are intrusive into the diabase series. Some part of the acid rocks, however, come into relation with the cherts and cherty Ordovicians, and, as far as can be observed, have not effected any marked alteration of the sediments. In view of their probable comparatively superficial origin and low temperature of consolidation, this is not surprising.

While much of the diabase was of the character of a tuff, undoubted massive lavas and intrusions occur, and if the diabase were pre-Ordovician one would expect in places where the Ordovician shore line came into relation with massive diabases that

coarse conglomerates containing diabase fragments would occur. None such have, however, been found.

The irregularities in the surface boundaries between Ordovician and diabase, and the more or less inconstant development of black cherts along the junction, as shown on the map, are features some of which are, I think, due to a misinterpretation of the field evidence. Some, however, are real, and I think they can be explained on the view that submarine vulcanicity started in Lower Ordovician times, that a mixed series, consisting largely of unbedded and bedded tuffs and lavas, with relatively minor intrusions, was developed, and passed gradually upwards into more normal sediments. There would be developed irregularities in thickness in the diabase series, and on subsequent folding and denudation the present more or less embayed junction between Ordovician and diabase would be produced.

The evidence as yet available of the relations of diabase and Ordovician is not, I think, so clear as to enable a positive statement of the Ordovician or pre-Ordovician age of the diabase to be made, but for the reasons given above I am at present inclined to group it with the Lower Ordovician sediments rather than as forming a distinctly pre-Ordovician series.

(*e*) *Physical Geography of the Lower Ordovician Period.*—Professor Gregory has given an interesting sketch of the probable relations of land to sea in Lower Ordovician times, based on his view of the pre-Ordovician age of the cherts and diabases. He correlates with the Heathcote rocks outcrops at Lancefield, Dookie, near Geelong, etc., and maintains that a barrier of pre-Ordovician land stretched across what is now Victoria, eastwards from a more or less N. and S. line from near Geelong through Heathcote to Dookie. These places, according to Professor Gregory, lie along the eastern margin of the Lower Ordovician sea, and define the easterly boundaries of the Lower Ordovician beds.

Holding as I do a different view of the origin and age of the cherts and the diabases, I am unable to agree with Professor Gregory in this sketch of the Lower Ordovician boundaries. In my opinion there are no good grounds for regarding the present eastern boundaries of the Lower Ordovician series as marking their most easterly development in Victoria. I regard the cherts

which lie on the eastern flanks of the diabase and granitic rocks of Heathcote as altered Ordovician rocks, and think that they probably continue for some distance unknown underneath the Silurian sediments.

South of Lancefield, and again north of Keilor, the igneous rocks are not represented at the surface, and the Ordovician and Silurian series come into direct relation with each other. Although no precise contact of the two series has been observed, it is probable that the Ordovicians pass underneath the Silurians, and that the latter are laid down unconformably upon them. I think the lineal development of the diabases at the surface may be due to their being brought up in or near the axis of a big fold of the Ordovician series, and if so, the Ordovicians may continue eastwards for some distance beneath the Silurian rocks. Of course a pre-Ordovician series must have provided the bulk of the detrital material from which the Ordovician sediments have been formed, and such a series may be represented underneath the Silurian series, but of its position we have, I think, no positive evidence. No Middle or Upper Ordovician rocks are known near the Heathcote district. It would appear that movements of elevation took place, and probably during the Middle and Upper Ordovician periods this was a land area. The exposure of the harder igneous rocks at the surface would lead to their forming a ridge which, where developed, probably defined the western shore line of the Silurian sea, along which coarse conglomerates containing cherts and diabase fragments were laid down.

(*f*) *Correlation of the Heathcote Rocks with Other Areas.*—Professor Gregory and Mr. Dunn have correlated with the rocks of Heathcote somewhat similar diabasic and cherty rocks from a number of other localities. References to these papers is given at the commencement of this paper. In most of the cases cited the rocks in question are either surrounded by rocks of much newer age or by rocks whose age is unknown. In such cases the lithological resemblance of basic rocks, and sometimes cherts, to the Heathcote series is considerable, and quite possibly may imply a similarity in age, but I think such a correlation, in the absence of stratigraphical relations, should be cautiously applied, especially in view of the recent work of Mr. Thiele,[1] in which

he has shown that cherts and jaspers associated with the serpentine area of Mt. Wellington, Gippsland, contain Upper Ordovician graptolites.

Mr. Summers[1] has also shown at Tatong that a series of cherts is interbedded with unaltered slates whose age is not definitely fixed, but is probably Ordovician.

11.—Conclusion.

With regard to the conclusions at which I have arrived in this paper, I find myself only in partial agreement with previous workers.

I am in agreement with Mr. Dunn in regarding the diabases as mainly effusive. With Professor Gregory I agree that the diabase is pre-Silurian, and with Dr. Howitt that the Ordovicians are altered along the contact with the diabase, and that the black cherts are altered Ordovician rocks. On the other hand, I disagree with Dr. Howitt, who regarded the diabase as a rock intrusive in Devonian times. I regard it as mainly effusive in origin and probably of Lower Ordovician age. With Professor Gregory I am unable to agree in the interpretation of some of the field evidence, and I differ from him in regarding the cherts as altered Ordovicians and the diabase as being probably Lower Ordovician in age, and in his interpretation of the relations of land and sea in Lower Ordovician times.

The new evidence which is brought forward in this paper is as follows:—

1. Some alteration in the geological boundaries and considerable alterations in interpretation of field evidence.

2. The finding of *Protospongia* and of other minute organisms in the Ordovician rocks, and the possible occurrence of Radiolaria.

3. The evidence for regarding much of the diabase as consisting of foliated diabase tuffs.

4. The explanation of the original composition and mode of silicification of the cherts.

5. The diabasic character of some of the Ordovician rocks.

6. The origin of the jasperoids.

7. The mode of origin of the micro-granite and its relation to the diabase.

8. The finding of corundum in the diabase and in the selwynite.

9. The possible mode of origin of the selwynite.

10. The evidence for the Lower Ordovician age of the cherts and of the diabase series.

DESCRIPTIONS OF PLATES XIV–XVIII.

The numbers of the rock sections have reference to the collections at the University of Melbourne. All the rock sections were photographed by Mr. H. J. Grayson, and were taken in ordinary light.

Plate XIV.

1. Rock section 618 × 11 diameters.

"Brecciated conglomerate," exposure in road running west between allotments 3m and 3j, Knowsley East. Possibly a coarse grained tuff. It consists of fragments of two types of diabasic rock more or less altered to chert by secondary silicification.

2. Rock Section 545 × 11 diameters.

Agglomerate of Photograph Knob, S. Heathcote. Larger and smaller angular diabasic fragments are set in a fine grained indurated ground-mass.

3. Rock Section 576 × 11 diameters

Boulder in foliated diabase of Red Hill, Heathcote. An agglomerate consisting of large and small angular fragments of diabase in a fine ground-mass.

4. Rock Section 583 × 11 diameters.

Diabase tuff, allotment 3q, Knowsley East. The rock is distinctly fragmental and contains secondary quartz and secondary felspars partially or wholly replacing disbase material.

Plate XV.

1. Rock Section 584 × 11 diameters.

Bedded diabase tuff (?) Tranter's Paddock, M. of W. Knowsley East. A silicified cavernous rock, cavities originally occupied by

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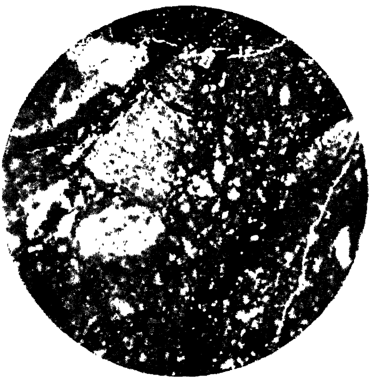

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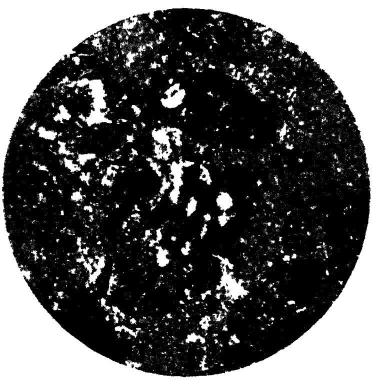

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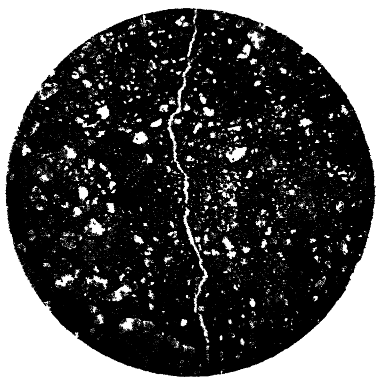

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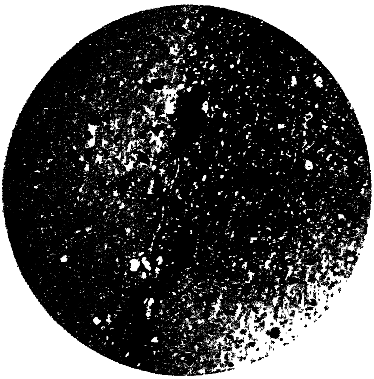

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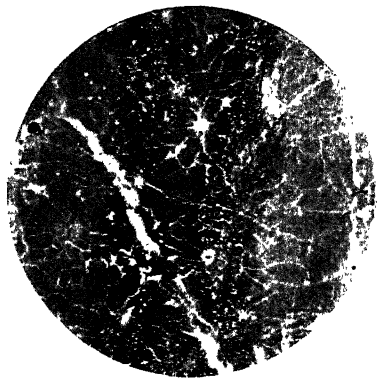

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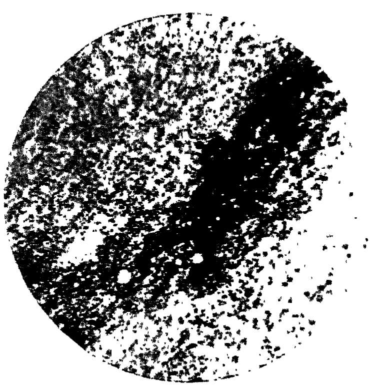

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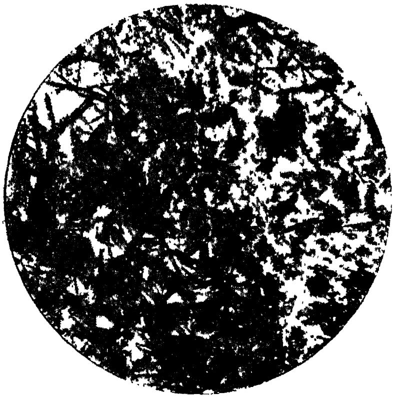

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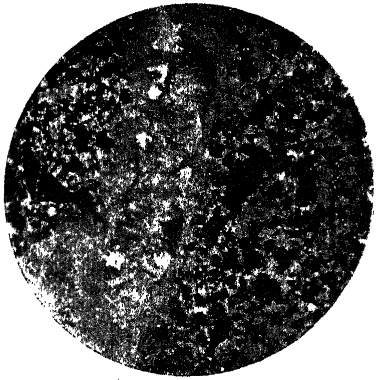

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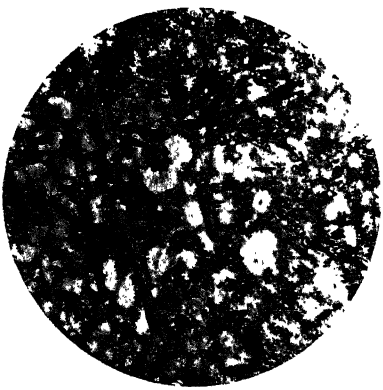

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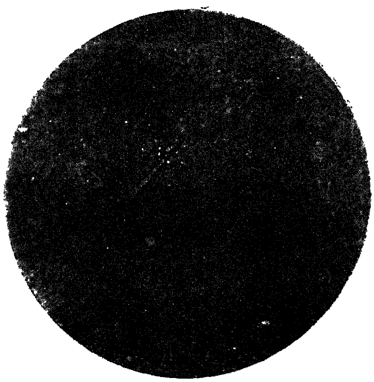
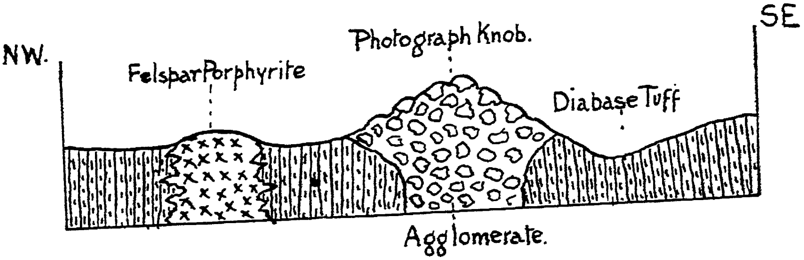
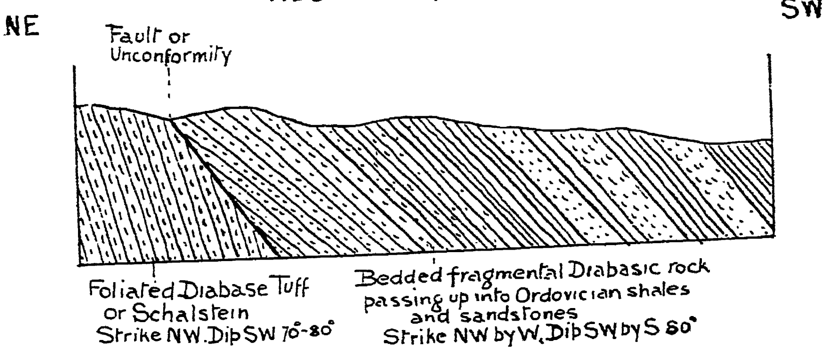
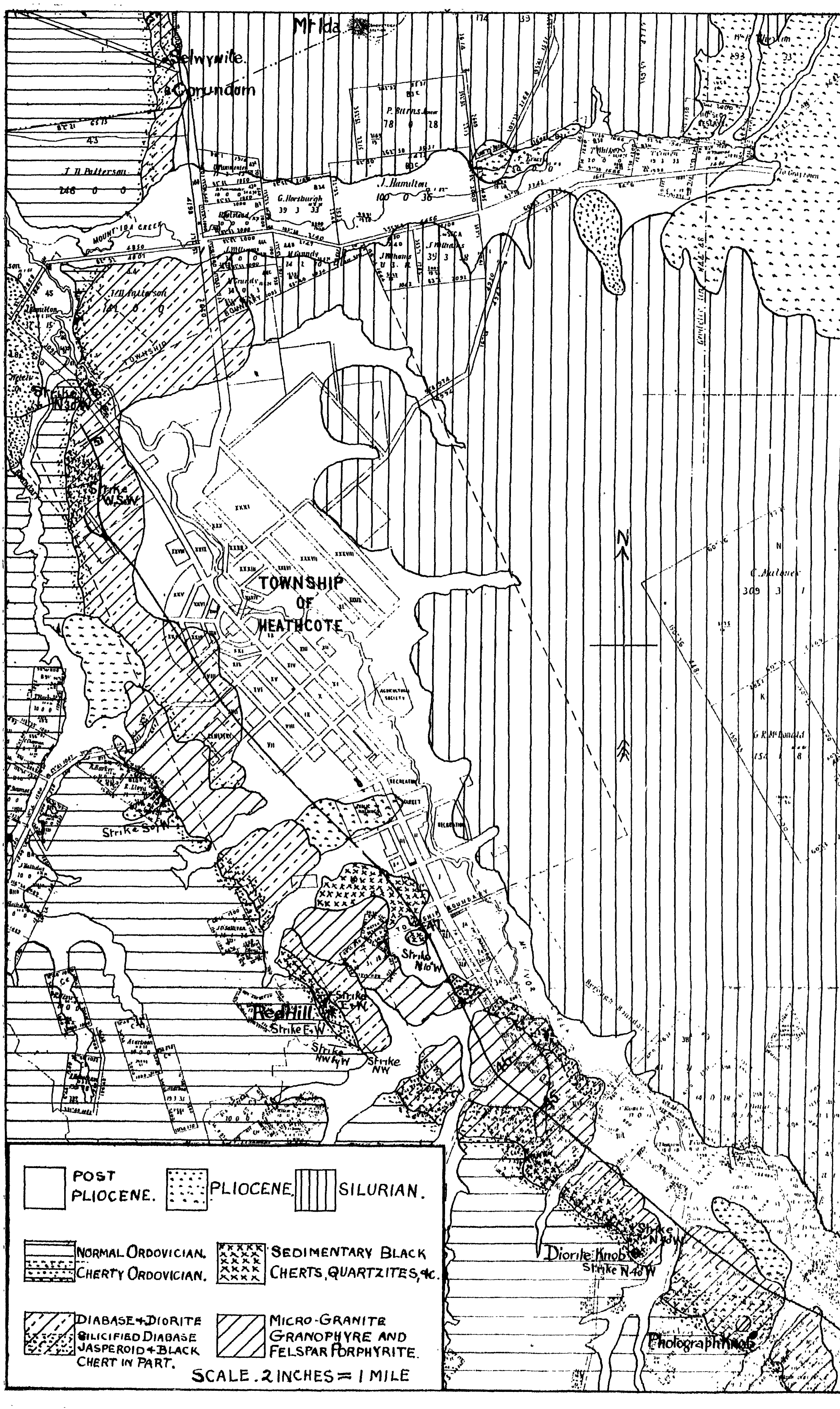


(1) SKETCH SECTION NW–SE ACROSS FELSPAR-PORPHYRITE AND PHOTOGRAPH KNOB, SOUTH HEATHCOTE.



(2) SKETCH SECTION NE.–SW. AT SOUTH END OF RED HILL, HEATHCOTE.





GEOLOGICAL SKETCH MAP OF THE HEATHCOTE DISTRICT.

felspars and actinolite (?) Irregular altered augite crystals lie in a fine-textured silicified ground-mass.

2. Rock Section 612 × 11 diameters.

Bedded chert, section on railway, 30 yds. S. of Gate 47, Heathcote Some of the dark patches are of igneous material. The circular colourless areas with inner walls (?) are probably organic. The rock has been intensely silicified.

3. Rock Section 549 × 11 diameters.

Jasperoid alteration of diabase, 300 yds. S. of selwynite outcrop and W. of Murray Road, Heathcote. The igneous texture of the rock has been completely lost by secondary silicification. Radial chalcedonic aggregates form the bulk of the rock and are traversed by later quartz veins.

4. Rock Section 592 × 11 diameters.

Calcareo-siliceous alteration of diabase or diabase tuff, 200 yds. N.W. of S. Heathcote Hotel, and E. of Murray Road. Calcareous areas represent the earlier alteration of the rock. Later silicification has obliterated much calcareous material, the boundaries of areas formerly calcareous being defined by dark lines in the present chalcedonic ground-mass.

Plate XVI.

1. Rock Section 550 × 11 diameters.

Boulder of corundum and green micaceous mineral from Gully just E. of jasperoid and 300 yds. S. of selwynite outcrop, Heathcote. Corundum occurs in elongated prisms and also in irregular masses at the right-hand side of the photograph. Orthorhombic pyroxene (?) occurs in broad prisms on the left-hand side, and the light background consists of a pale green micaceous mineral.

2. Rock Section 551 × 18 diameters.

Silicified diabase with corundum, a few feet from jasperoid and 300 yds. S. of Selwynite outcrop, Heathcote. The long prisms formerly corundum, are now replaced by secondary minerals. The igneous texture of the rock is partially obscured by radial crystallization of chalcedonic silica.

3. Rock Section 566 × 11 diameters.

Selwynite from outcrop junction of Murray Road and road running N.W. towards Derrinal; about 2½ miles N. of Heathcote

township. The vein crossing the photograph consists of a light green micaceous mineral polarizing brightly. The pale background of the rock is a low polarizing aggregate of a micaceous or scaly mineral which is green in hand specimen. Grains of opaque chromite occur and many granular brownish crystals of altered orthorhombic pyroxene (?)

4. Rock Section 634 × 11 diameters.

Fossiliferous Ordovician shale 20′ W. of "brecciated conglomerate" in road between allotments 3m and 3j, Knowsley East. The rock is crowded with sections of sponge-spicules. Circular chalcedonic areas may represent altered sections of Radiolaria.

Plate XVII.

Fig. 1. Section through Photograph Knob, Heathcote.
Fig. 2. Section at Red Hill, Heathcote.

Plate XVIII.

Geological Sketch Map of the Heathcote District.

[PROC. ROY. SOC. VICTORIA, 21 (N.S.), PT. I., 1908.]

ART XI.—*Variations in the Anatomy of Hyla aurea.*

BY GEORGINA SWEET, D.Sc.,

Melbourne University.

(With Plates XIX., XX.).

[Read 9th July, 1908.].

A number of variations in the morphology of this form have been already described (see Bibliography), but one occasionally comes across others, during the dissection of the numbers which pass through the hands of Junior Students in Biological Laboratories. It is desirable that a record should be made of these. Accordingly there are gathered together here the more important of those noticed during the last few years in the Biological Laboratory of the University of Melbourne. I wish to thank Professor Baldwin Spencer, Dr. T. S. Hall and others for directing my attention to variations which might not otherwise have come under my notice.

I.—Blood Vessels.

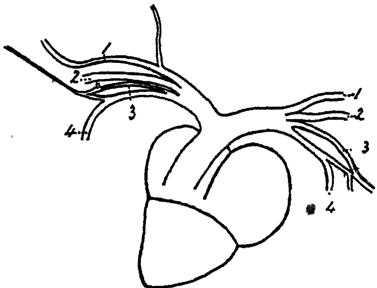
(i).—Arteries.

There have recently come under my notice three individuals of this species, two of which (A and B) have 4 aortic arches on either side instead of 3, as in a normal specimen, the third (C) having 4 arches on the one side, but only 3 on the other. One of these was found some years ago, one in 1907, one in 1908. In each (see Text figures 1-3) the additional arch lies

FIG 1

Specimen A of *Hyla aurea*, having four arterial arches in the adult.

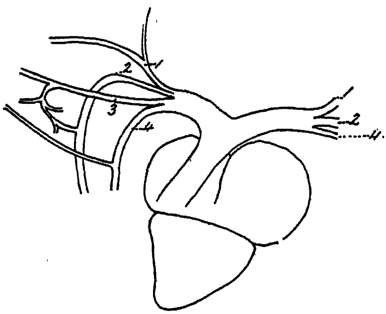
1. Carotid arch.
2. Systemic arch.
3. Vestigial arch.
4. Pulmo-cutaneous arch.



Specimen B of *Hyla aurea*, having four arterial arches in the adult.

(Reference letters as in Text-figure 1).

FIG 2



Specimen C of *Hyla aurea*, having four arterial arches in the adult.

(Reference letters as in Text-figure 1).

FIG 3

between the systemic and pulmo-cutaneous arches, and arises from the pulmo-cutaneous arch, close to its origin from the right or left half of the truncus arteriosus. It then runs outwards between the muscles, M. petrohyoideus II. and III., and on one side (R) of individual A, it coils about considerably dorsal to M. petrohyoideus III. and ventral to the systemic arch, which crosses the path of this vessel on its way round the oesophagus. In both A and B, and on each side, the extra arch opens into the cutaneous artery soon after the latter leaves the pulmo-cutaneous arch. In individual A (Text figure 1) the extra arch divides into two vessels, one coiling round to meet the cutaneous artery, the other running forwards and outwards to the skin. In the other individual B (Text figure 2) the extra arch does not coil, but runs almost straight into the cutaneous artery, giving off just before this union, a small vessel which runs inwards to the muscles of the laryngeal wall. I was unable to determine whether the systemic also gave off a

vessel to the larynx, as it had been cut previously to coming into my possession. There was in this animal no vessel to be found corresponding to that going to the skin from the extra arch in the other individual. In C (Text figure 3) the extra arch on the R. side does not open into the cutaneous artery at all, but gives off a large and long branch, accompanying it to its destination. The rest of this arch curls inwards to open into the systemic arch after giving off branches to the surrounding muscles.

It is quite evident that this extra arch corresponds to the 3rd branchial arch of the embryo which normally disappears in the frog, but has in these cases been retained.

In a fourth individual (Text figure 4) there were only the

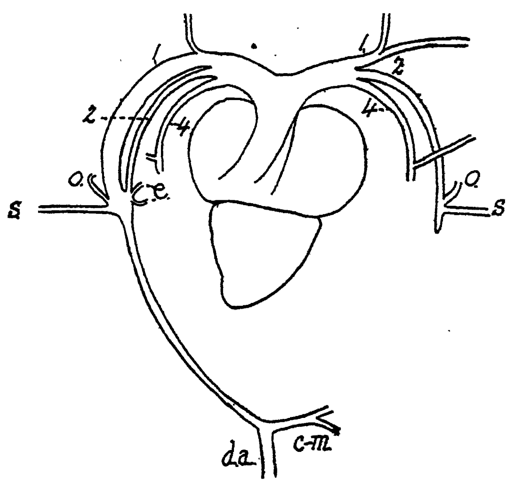


FIG 4

Individual of *Hyla aurea*, showing abnormal Carotid and Systemic arches.

1. Carotid arch.
2. Systemic arch.
4. Pulmo-cutaneous arch.
o. Occipital artery.
s. Subclavian artery.
e. Oesophageal arteries.
d.a. Dorsal aorta.
c.-m. Coeliaco-mesenteric artery.

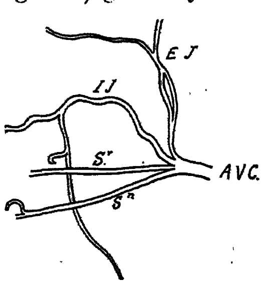
usual 3 arches, of which only the L. carotid and R. and L. pulmo-cutaneous arches are normal. The right carotid arch, after giving off the lingual artery, continues round as an abnormally large vessel to empty into the right systemic arch just where the latter gives off the occipital and subclavian arteries, and two branches to the roof and sides of the oesophagus. There is no branch corresponding in destination to the ordinary carotid artery on this R. side. On the left side the carotid arch is normal, but the left systemic arch ends abruptly just after giving off the occipital and subclavian arteries.

Thus we have here on the right side a disappearance of the part of the right half of the dorsal aorta anterior to the 1st branchial arch of the tadpole; while the connection between this arch and the 2nd arch, which usually persists as a solid, connective-tissue thread, the ductus Botalli, is here still widely open.

On the left side, the part of the left half of the dorsal aorta posterior to the origin of the subclavian artery has disappeared. It is difficult to understand how the brain gets its normal supply of blood, since the right carotid artery is absent, and no other vessel appears to take its place, and the left carotid artery is only normal in size and distribution. The arteries in general appear less subject to variation than do the veins. It may be noticed that occasionally the oesophageal arteries leave the systemic arch behind instead of in front of the subclavian arteries.

(ii).—*Veins.*

These show a curious tendency to split into 2 branches, reuniting a little distance on, thus forming a loop (see Text figure 5) generally not surrounding any special structure. This



Abnormalities in veins belonging to the precaval system of *Hyla aurea.*

A.V.C. Anterior Vena Cava.
E.J. External Jugular Vein.
I.J. Internal Jugular Vein.
I. Innominate Vein.
S^v. Subscapular Vein.
S^n. Subclavian Vein.

FIG 5

looping of the veins, especially seen in the mandibular, external jugular, and femoral veins, has been much more conspicuous in the frogs this year (1908) than previously. The chief variations found are as follow:—

Anterior Vena Cava.—There is usually not only one lingual vein, but a number of smaller ones coming from the floor of the mouth and entering the mandibular vein, chiefly in front of the entrance of the main lingual vessel. Rarely, the lingual itself arises by several large branches which unite close to the external jugular vein. The mandibular vein receives generally a large branch from the skin just as it turns inwards at the angle of the jaw. Occasionally a connection was found between the two external jugular veins across the ventral surface of the body.

The second main vein of this system, the so-called innominate of the Amphibia, and its branches, are the most variable in the body. The innominate vein may be comparatively long, i.e., up to 5-6 mm. At other times, it is entirely absent, its two component branches entering the anterior vena cava side by side (see Text figure 5). Rarely, the internal jugular, subscapular, and main subclavian veins all enter a short, wide vessel, which joins the external jugular vein to form the anterior vena cava (see Text figure 6). As an exaggeration along

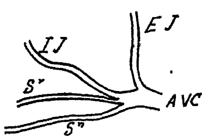


FIG 6

Abnormal precaval venous system of *Hyla aurea*.

(Reference letters as in Text-figure 5).

this same line of variation, the whole innominate vein, with a length of 1 mm., has been seen to empty into the subclavian vein, at about one-half of the length of the latter (see Text figure 7). A further development of the condition in which

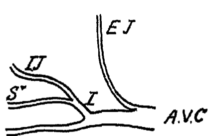
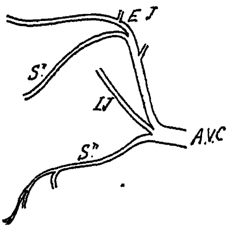


FIG 7

Abnormal precaval venous system of *Hyla aurea*.

(Reference letters as in Text-figure 5).

there is simply no innominate vein, is seen in a case (see Text figure 8) in which the subscapular vein entered the mandibular



Abnormal precaval venous system of *Hyla aurea*.

(Reference letters as in Text-figure 5).

FIG 8

just before the latter was joined by the lingual vein—the internal jugular uniting with the external jugular and subclavian to form the anterior vena cava. On the other hand, it is a comparatively common occurrence to find the subscapular vein entering at any point of the subclavian vein.

The internal jugular vein itself occasionally shows a curious branching (see Text figure 5). In addition to its usual branches in the head, it sometimes receives two very large dorsal or vertebral veins, and in addition, in two examples, these were joined by a very large vessel coming from the roof of the oesophagus. In one case, this originated in a large plexus. This takes place on each side of the body, this oesophageal vein running ventral to the brachial nerve and subclavian artery, and dorsal to the subscapular and subclavian veins.

With the exception of the variations mentioned above, the subclavian veins do not show any marked abnormalities. In one instance, however, a vein arising from the oesophageal wall. entered the subclavian vein, instead of going further forward to the internal jugular vein, as described above. It is also quite a common occurrence to find one, or often two vessels from the coracoid region entering the subclavian vein at varying distances along its length.

The Posterior Vena Cava appears free from variations.

The Portal Systems are also fairly constant in their arrangement. A few abnormalities, however, may occasionally be found, e.g., an extra renal portal vein on one or both sides, a

looping of the femoral vein just before its division into renal portal and pelvic veins, or a plexus with large or small vessels at the same part. In two specimens I came across a curious condition of the anterior abdominal vein, which, though full of blood posteriorly, stopped short, in one case, half way along its length, in the other somewhat further forward. In neither individual therefore, was the blood able to pass forwards to the liver in the usual direct manner from this vessel, nor was I able to find any abnormal communication with other vessels.

II.—Spinal Nerves.

Since the publication of my previous paper on the Variations of the Spinal Nerves of this form, some few additional points have come to light, although in the main there is nothing fresh.

I am adhering to the numeration of the nerves in this previous paper for the sake of easier comparison therewith.

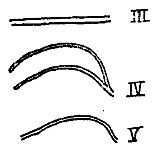
II.—The Hypoglossal.—The muscular branches of this nerve vary considerably in their point of origin. Sometimes they arise much closer to the vertebral column than at others, and then often by a single large branch which can be easily seen without dissection. This, later, breaks up into the branches supplying the several muscles. This has been much more conspicuous this year than usual. The hypoglossal is usually a moderately thin nerve, but in one instance noted it was as large as the brachial nerve, which, however, was much smaller than usual. Here, also, a large additional coraco-clavicular nerve was given off from the hypoglossal.

This year there has been a marked tendency to a duplicating or splitting of the spinal nerves either as, or before they leave the spinal canal. This is true in a few cases of the hypoglossal, the two parts running side by side and each branching in the normal manner.

III.—The Brachial is very constant, though the same looping seen in the veins this year is seen in this nerve also, in a few instances. In one or two of these, the IInd nerve fused with one part of the loop, leaving it again before the junction.

IV.—In one instance IV. was equal in size to III., and the two completely fused together just after the coraco-clavicular had been given off. This is evidently an exaggeration of the

condition shown in Fig. 5, iii. (Sweet, '97). The duplication of nerves is seen also in this one (see Text figure 9 of the present



Brachial and two succeeding nerves of right side.

FIG 9

paper), the anterior division running sharply forwards first ventral to, then turning dorsal to, the transverse process of the IIIrd vertebra, and running back to accompany the posterior division to its destination.

V., *VI.* and *VII.* call for no comment, except that one may rarely be absent on one or both sides—especially the 5th—the vertebral column being normal in these cases.

VIII., *IX.*, *X.* and *XI.* are, as previously described, subject to considerable variation. The variations show no departure in general from those then given. Fig. I. (i) appears fairly often, and then generally with XI. entering the sciatic nerve, after the crural has been given off, as in Fig. 4 (i.). In cases where XI. is large, and has such an intimate relation with the sciatic plexus, one is generally sure of finding a XIIth nerve, indicating the more primitive condition.

This condition is somewhat similar to that shown by Cole for *Rana temporaria*, without a post-coccygeal nerve, and for *Rana esculenta*, with a post-coccygeal nerve.

A number of examples of double VIIIth nerves were found, generally on one side only. They were sometimes equal in size, less often the more posterior division was very fine indeed.

As examples of the more advanced condition of this plexus may be cited the following:—VIII. large, IX. normal, X. smaller than usual, XI. absent (cf. loc. cit., Fig. 2, viii.). In another case in which VIII. and IX. were equally large, and fused high up, to form the sciatic nerve, the Xth and XIth were very small indeed, and their plexus received a tiny branch from the fused VIII. and IX., and at a lower level gave back to them an even smaller twig.

XII.—This is found in 3-4 per cent. of cases, as previously described, and only when XI. is larger than usual.

It will be seen that I am still of the opinion that, so far as evidence shows up to date, the sacral plexus appears to be moving forwards, the coccygeal nerve gradually diminishing in physiological importance, as previously shown by Adolphi ('93, '95, '98—) and myself ('97—). Cole (p. 116) acknowledges the fact that as "the vertebral axis shortens up from behind, forwards, to produce the complex known as the urostyle, several of the most posterior spinal nerves are eliminated in the process," as shown by Adolphi (loc. cit.). At the same time, he considers that the sacral plexus is moving back—i.e., he apparently believes that up to a certain stage a reduction of spinal nerves in the sacral region takes place, followed in the next stage by an addition of nerves in the same relative positions as were those which have been lost. Until we have much more definite evidence of such an apparently uneconomical method of development, either in the individual or the group, it is unnecessary to imagine such a process.

As to the statistical method employed by Adolphi and myself, which Cole considers open to criticism, while agreeing that the thickness of a nerve may not be an infallible guide as to its physiological power, it appears to me—in the absence of direct evidence to the contrary in the Amphibia—that it may be accepted as an indication of probable importance.

III.—Urinogenital System.

Variations in the structure of this system are very rare. In one instance, found this year, there was present on each side in a male frog, a medium-sized, well-formed oviduct. This extended from the funnel at the anterior end, as far as the middle of the length of the kidney, where it ended abruptly. For the greatest part of its length it coiled in the usual manner. The two sides were similar. No trace of a "Bidder's organ" could be found, and the vasa efferentia and fat bodies were normal. From a surface examination the testes also appeared normal, but a series of sections showed clearly the presence of 15-20 ova, scattered irregularly through the substance of the testes,

generally singly, but sometimes in groups of two. Here, for some reason or other, the Mullerian duct has gone on developing more than is usually the case in the male frog, and some of the cells of the germinal epithelium have formed ova; but still no communication has been established between the oviduct and the cloaca. There can be, therefore, no functional activity of the oviduct, at all events.

IV.—Skeleton.

(i).—Vertebral Column.

Variations in the skeleton are also to be met occasionally. The most remarkable example which has been seen here is that shown in Pl. xix., Fig. 1—for which figure I am indebted to Professor Baldwin Spencer. In this individual (W), it will be seen that the neural arches, as well as the bodies of the vertebræ, are very much distorted, those of the 7th and 8th being fused together, that of the 9th being completely fused with the urostyle. The malformation of all the processes is very conspicuous. Although there is the correct number of transverse processes on the right side, their number and relationships on the left side are quite abnormal. On reference to the figure, it may be observed that the left transverse process of the 2nd vertebra has become articulated to the 1st vertebral body—that of the 3rd is now on the 2nd, and so on to the large transverse process of the sacral vertebra 9, which is attached to the hinder part of the left side of the fused 7th and 8th bodies—while the part of the urostyle representing the 9th body, has on its left side a small backwardly directed process, and on the right the large sacral process is articulated with it.

In a second individual (X) (see Pl. xix., Fig. 2), both sides of the skeleton showed a somewhat similar condition to that present on the left side of the previous one (W), i.e., the transverse processes of each of the 2nd to the 9th vertebræ are transferred to the vertebra in front. The 9th vertebra, which is not fused with the urostyle, has no true transverse processes. Its posterior zygapophyses, however, are very much elongated, and, viewed from below, may be seen to have a connection with the side of the neural arch, as though a rudimen-

tary transverse process on each side had become fused with the zygapophysis, as it elonganted to take on the general functions of the transverse processes. The bodies of vertebræ 1 to 7 are normal. That of 8 is procoelous, but is abnormal posteriorly where it has two convex surfaces, one on each side, as is normal for number 9. The latter, again, is abnormal anteriorly, its 2 concave surfaces fitting on to number 8. Posteriorly 9 is normal except that its 2 convexities are very prominent, and the urostyle is correspondingly deeply concave.

In yet a third individual (Y), (see Pl. xix., Fig. 3), exactly the same condition of the 8th and 9th processes and vertebræ is present: i.e., the sacral processes are on the 8th vertebra, and 9 carries two very long posterior zygapophyses, equal in size to the transverse processes of the 4th vertebra—but, as contrasted with (X), the rest of the vertebral column is quite normal. So that, while in (Y) the large processes of the 3rd vertebra are normal, in (X) they are situated on the 2nd vertebra. The centra of (Y) are very similar to those of (X), except that the hinder end of the 8th body is very irregular on the left side, the opposed part of the 9th being correspondingly irregular—the hinder end of 9 and the urostyle are normal.

It is not unusual to find processes on either or both sides of the urostyle itself in otherwise normal frogs (e.g., Pl. xix., Figs. 4 and 5). Sometimes these processes are as long as those of the 5th, 6th and 7th vertebræ, and evidently represent those of a potential 10th vertebræ fused with the urostyle. The bodies of the vertebræ of the sacral region are normal in these specimens.

Since writing the above, a 6th skeleton, evidently that of *Hyla aurea*, has been handed to me. This individual (V) is shown in Pl. xx., Figs. 8a, 8b. The whole vertebral column is very short. This is due, primarily, to a widespread fusion of parts in its anterior region. Vertebræ 6-9 are normal as regards size, shape and relationships, though the body of 8 shows hardly any ossification. The remaining vertebræ are, however, much changed. Vertebra 1 consists of a ventral body, carrying on its right side one half of the normal neural arch, with the right concave articulating surface, which receives the corresponding condyle on the right exoccipital bone. The left half of the

neural arch is wanting—and correspondingly the left exoccipital has no condyle, the vertebral column being simply very closely connected with the skull on the left—so closely that it is only after careful examination that one is sure that it is not fused. The bodies of the 2nd, 3rd, 4th and 5th vertebræ are completely fused, and somewhat distorted. This ventral fused mass is procoelous, and convex behind. The bodies of the 2nd, 3rd and 4th vertebræ are incomplete on the left side (see Pl. xx., Fig. 8b). The neural arches of the 2nd and 3rd, and of the 4th and 5th, are fused in a peculiar distorted way, which may be readily seen on reference to Pl. xx., Fig. 8a. The transverse processes, which are slightly broken, appear to have been nearly normal on the right side. On the left, however, those belonging to the 2nd and 3rd vertebræ are absent, the space left in this way and by the incomplete centra forming a long oval opening through which, presumably, the 2nd, 3rd, 4th and 5th spinal nerves left the spinal column on the left side. The transverse processes of the 4th and 5th vertebræ on this left side arise from the region of the anterior part of the 5th neural arch by a broad common base, which soon splits into 2, one turning outwards and forwards, the other running outwards and very slightly backwards. The transverse processes of the 6th and 9th are appreciably larger on the left than on the right. The general relations of the vertebræ will be seen clearly on reference to the Plate xx., Figs. 8a and 8b. The rareness of such variations in *Hyla aurea* may be guessed from the fact that the variations herein recorded have been gathered from over two thousand frogs.

Fusion of vertebræ is not unknown in the Anura, though I am not aware of its having been previously recorded in *Hyla*. In addition to the cases in *Pipa* and *Xenopus*, figured by Ridewood (1897), the following are the chief records available to me:—

1 + 2	Pelobates fuscus,	symmetrical.	Adolphi, '95, figs. 2, 3
„	Rana mugiens, not	„	Benham,'94, figs. 1, 3, 4, 6
1 + 2 + 3,	Pelobates fuscus „	„	Adolphi, '95, fig. 5
2 + 3	Bufo cinereus,	„	„ '98, fig. 1
3 + 4	„ „	„	„ „ 2
„	Rana mugiens, not	„	Benham, '94, figs. 1, 2
3 + 4 + 5,	„ „ „	„	„ '94; figs. 7, 8, 9, 10

4 + 5 + 6,	Bufo cinereus, symmetrical.		Adolphi, '98, fig. 3
7 + 8	Rana mugiens, not	,,	Benham, '94, figs. 1, 2
8 + 9	Rana esculenta	,,	Howes, '93, fig. 1
,,	,, ,, ,,	,,	Cole, '01, fig. 4
,,	,, ,,	,,	Ridewood, '02, p. 46
8 + 9	Pelobates fuscus	,,	Adolphi, '95, figs. 10, 11
8 + urostyle	Bufo cinereus ,,	,,	Adolphi, '98, figs. 5, 6, 7, 8
8 + 9 + urostyle,	Bufo variabilis, nearly ,,	,,	Adolphi, '93, fig. 4
,,	,, pantherinus ,,	,,	Benham, '94, fig. 16
9 + urostyle,	Bufo variabilis	,,	Adolphi, '93, figs. 6, 7
9 + 10 + (?)urostyle	Pelobates fuscus ,,	,,	Adolphi, '95, figs. 2, 3, 4, 6, 7, 8

From this table it is easily seen that the fusion of vertebræ 2, 3, 4 and 5, in individual (V) of Hyla is somewhat more extensive, resulting in greater distortion and loss of parts, especially as involving one of the condyles of the skull, and the 2nd and 3rd transverse processes, and the left side of the bodies, resulting in a shortening of the whole vertebral column. The curious arrangement found in (W), (see Pl. xix., Fig. 1), whereby each vertebra from 2-8 carries a transverse process belonging on the left, apparently to the vertebra behind, as well as its own on the right, is comparable in part with that shown by Benham ('94, Figs. 1 and 2), though brought about in a different manner. There is there, however, no interference with the arrangement of the sacral processes, such as we find here. In this respect this specimen of Hyla may rather be compared with the vertebral column figured by Adolphi ('98, Figs. 7 and 8), though not exactly similar even to that, the body of vertebra 9 being in that case still distinguishable from the urostyle, while here it is completely fused. The position of the sacral processes on 8 instead of on 9, as seen here in (X) and (Y), may be compared with Adolphi's ('98), Fig. 5, though there the 9th is indistinguishable from the urostyle, while here it is not in any way fused. A similar disjunction is seen in the specimen of *Rana temporaria*, quoted by Lloyd Morgan (Nature, vol. 35, p 53), in which the right sacral process is carried by the 9th vertebra,

while the left sacral process is carried by the 8th—also somewhat similarly in *Bombinator* sp., by Howes, in which he found the right sacral process on the head of the urostyle (= "coccygeal sacrum"), the left being, presumably, on the 9th vertebra.

Accepting the view that the positions of the vertebræ are determined by the original myotomes of the embryo, the pelvis being only secondarily affected, it is easy to understand that not only may any vertebra become sacral in function, but, further, if the iliac cartilages be disturbed or irregular in position, the sacral processes will become correspondingly irregular in their attachments to the relatively fixed vertebræ.

The existence of the processes belonging to a potential 10th vertebra, which is not infrequent in *Hyla aurea*, and is exemplified in Pl. XIX., Figs. 1, 4 and 5, has also been noted by Adolphi in *Bufo cinereus*, etc.

In view of our present unsatisfactory method of estimating the homologies of similar structures (see Parker, '96, and Bateson, '92), I have simply recorded in detail the variations found, numbering the parts concerned according to the conventional manner, and giving exact drawings to scale of the same.

(ii).—Appendicular Skeleton.

The curved epicoracoids characteristic of the Hylidae, as of other families of the Arcifera, vary somewhat in their relation to one another in *Hyla aurea*. The more usual condition is that in which, while not firmly attached to one another, the right epicoracoid lies ventral to the left—but in approximately 4 per cent. of individuals the reverse is the case, the right being dorsal to the left.

In a few instances variations are found in the limbs. Thus in one case, while one foot was quite normal, the phalanges of the other foot showed a curious variation from the numbers characteristic of each toe (see Pl. xx., Fig. 6). Thus, instead of the 1st, 2nd, 3rd, 4th and 5th toes containing 2, 2, 3, 4, 3 phalanges respectively, as is usually the case, they here contained 2, 3, 4, 3 and 3 respectively—i.e., the second and third toes had each one more phalanx than usual, and the fourth one less than usual, the third toe being the longest, instead of

the fourth, as is usual. The length of the metatarsals also was abnormal—the 4th, and especially the 5th, being much shorter than the 3rd, instead of, as usual, equal in length with it.

In another individual (Pl. xx., Figs. 7a and 7b), both feet were abnormal, and also unlike one another. In the left foot there were only 4 toes, the metatarsal and phalanges of the first being absent. In the right foot there were 6 toes, an additional metatarsal and 2 phalanges being present on the postaxial side of the normal 5th toe. The metatarsals of the 3rd, 4th and 5th toes are normal, that of the additional toe being only equal in length to that of the 2nd. The bases of the 4th and 5th metatarsals, while not completely fused, are partially so.

In a third individual, the right foot was normal, as also the calcar, 3rd, 4th and 5th toes of the left foot. The 1st toe on the left foot contained only the one metacarpal and no phalanx, as in the thumb. The 2nd toe contains only the one metacarpal and one phalanx. The metacarpals of both 1st and 2nd toes are swollen distally.

There is no appreciable difference in the other bones of the limb in any of the above cases.

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EXPLANATION OF PLATES XIX. AND XX.

Fig. 1.—Whole vertebral column of specimen W, of Hyla aurea, showing fused 7th and 8th vertebræ, and 9 and urostyle.

Fig. 2.—Whole vertebral column of specimen X, with each pair of transverse processes attached to the vertebra in front of the normal one.

Fig. 3.—Vertebræ 6, 7, 8, 9 and urostyle of specimen Y, showing sacral processes on vertebra 8.

Figs. 4 and 5.—Vertebræ 8, 9, and urostyle of specimens ZA and ZB, showing well-developed processes on the urostyle.

Fig. 6.—Right foot, showing abnormal 3rd and 4th toes, dorsal view.

Figs. 7a, 7b.—Right and left feet respectively, showing abnormality in toes of each. Dorsal view.

Figs. 8a, 8b.—Whole vertebral column of individual V, showing fusion of vertebræ, etc. 8a, Dorsal view. 8b, Ventral view.

In each case the figures are life-size.

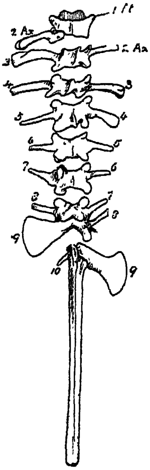


Fig 1

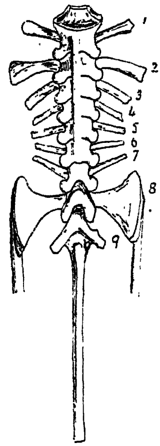


Fig 2

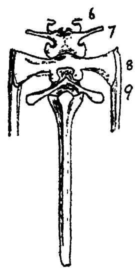


Fig 3

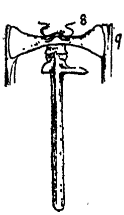


Fig 4

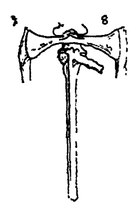


Fig 5

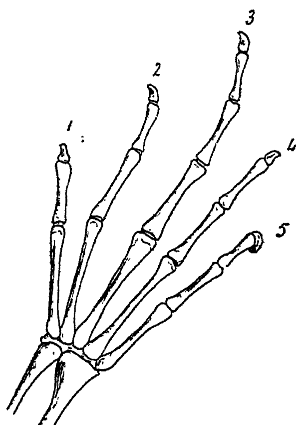


Fig 6

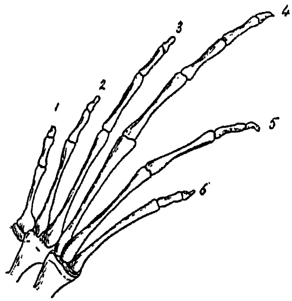


Fig. 7a

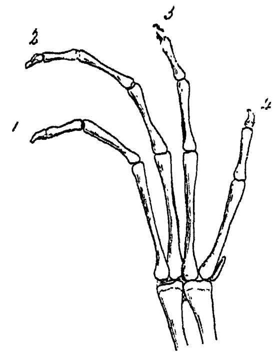


Fig 7b

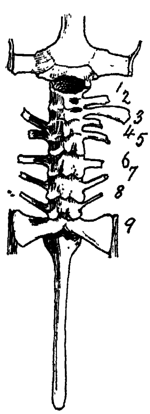


Fig 8a

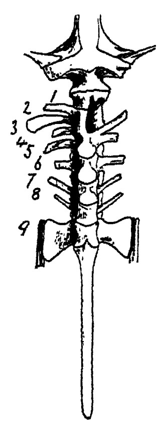


Fig 8b

[PROC. ROY. SOC. VICTORIA, 21 (N.S.), PT. I., 1908.]

ART. XII.—*On Some New Species of Victorian Marine Mollusca.*

BY J. H. GATLIFF AND C. J. GABRIEL.

(With Plate XXI.).

[Read 9th July, 1908].

The present paper describes four new species, figures of which are also given.

Marginella victoriae. sp. nov.

(Pl. XXI., Fig. 5)

Shell rather small, white, semi-translucent, solid, shining. Ovately biconical. Whorls about four, suture barely discernible. Outer lip much thickened, sinuated at its junction with the body-whorl, finely denticulated on its inner edge. Columella quadriplicate. Aperture long, rather narrow, widening towards the base. Dorsum, faintly plicately noduled at the shoulder of the body-whorl.

Dimensions of Type.—Length, 3.6; breadth, 2.mm.

Locality.—Dredged Western Port. In shell sand Portsea, Port Phillip.

Obs.—In Tasmania this shell has been wrongly identified as *M. rufula*, Gask., a banded species found at the Cape of Good Hope.

Type in Mr. Gatliff's collection.

Daphnella bastowi, sp. nov.

(Pl. XXI., Figs. 1-4).

Shell small, greyish white, whorls five and a-half, convex, somewhat angled below the suture, which is impressed. The apex is dome-shaped, consisting of two whorls, the first being very small; they have numerous spiral striae, crossed at right

angles by others of about double strength, but the spirals are more numerous, the other whorls are ribbed longitudinally, the ribs having a slight spiral trend; these ribs terminate a little below the suture, the intervening space carrying rather closely set angularly bent threads. Under the microscope these are thickened at the base and sharp at the edge, resembling a propeller-blade, their contour following the outline of the sinus. Between the ribs the area is concave and cancellated, the spirals are somewhat stronger and appear on the ribs. Outer lip thin, crenate, sinus rather deep, not broad. Inner lip somewhat concave; channel short, slightly everted.

Dimensions of Type.—Length, 4.; breadth 1.75 mm.

Locality.—Dredged between Phillip and French Islands, and off Stony Point, Western Port.

Obs.—Named after Mr. R. A. Bastow, to whom we are indebted for the skilled drawings of this and the other species figured in this paper.

Type in Mr. Gatliff's collection.

Phasianella nepeanensis, sp. nov.

(Pl. XXI., Figs. 9, 10).

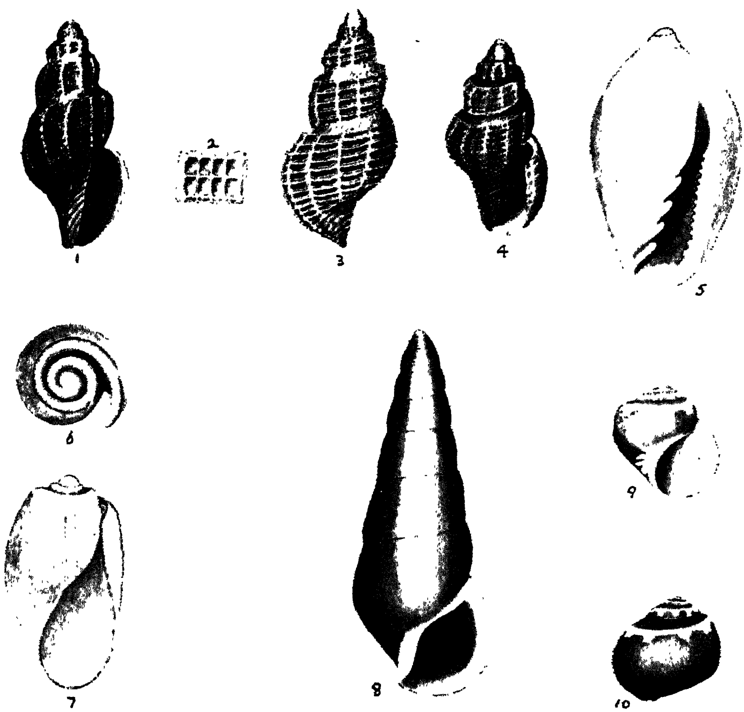
Shell small, smooth, globose, fragile; spire scarcely exsert. Whorls, five, rapidly increasing, aperture semi-circular, outer lip sharp, inner lip curved, rimate. Colour, pink with white markings, which vary a good deal, but usually include a band of rounded white spots on the shoulder of the body-whorl, and another similar one just below the periphery.

Size of Type.—Height, 1.7; width, 1.8mm.

Locality.—Flinders, Western Port; Ocean Beach, near Point Nepean.

Obs.—The shape of this shell is so different to our other species of the genus that it was with some hesitation we placed it here; but a comparison with a similar South African form, *P. neritina*, Dunker, decided us to do so. Colour is not of much use in determining species in this genus, as the markings vary so greatly in the same species, but in the present instance they appear to be fairly constant.

Type in Mr. Gatliff's collection.



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Rissoina rhyllensis, sp. nov.

(Pl. XXI., Fig. 8).

Shell simple, attenuate, light brown colour. Whorls, eight, flatly convex, sutures lightly impressed. Apex blunt, consisting of two whorls of lighter colour, which are smooth and shining; the remainder appear smooth, but are very finely, spirally, striate when seen under lens, the striae being crossed by faint longitudinal costae.

Aperture oblique, labrum simple, somewhat incrassate; columella with a rather thick callus.

Dimensions of Type.—Length, 6.7; breadth, 2.3 mm.

Locality.—Dredged between Phillip and French Islands, Western Port, about 5 fathoms (type); San Remo; Ocean Beach, Point Nepean.

Obs.—From most members of the Genus, this species must be really distinguished by its smoothness. The colour of specimens is somewhat variable, and in one instance the shell is brown and the whorls have an encircling band of greyish colour ascending to the apex, centrally situated and strongest on body-whorl. This zone of colour covering about one-quarter the width of the penultimate, and in another there are five narrow brown lines on the body-whorl.

Type in Mr. C. J. Gabriel's collection.

EXPLANATION OF PLATE XXI.

Fig. 1.—Daphnella bastowi, n. sp., front view.
Fig. 2.—Daphnella bastowi, n. sp., detail of sculpture.
Fig. 3.—Daphnella bastowi, n. sp., dorsal view.
Fig. 4.—Daphnella bastowi, n. sp., front view, shell tilted.
Fig. 5.—Marginella victoriae, n. sp.
Fig. 6.—Akera tasmanica, Beddome, apex, end on.
Fig. 7.—Akera tasmanica, Beddome, front view.
Fig. 8.—Rissoina rhyllensis, n. sp.
Figs. 9, 10.—Phasianella nepeanensis, n. sp.
All of the figures variously magnified.

[Proc. Roy. Soc. Victoria, 21 (N.S.), Pt. I., 1908].

Art XIII.—*Additions to and Revision of the Catalogue of Victorian Marine Mollusca.*

By J. H. GATLIFF and C. J. GABRIEL.

[Read 9th July, 1908].

In the following paper 85 species are dealt with; in 38 cases the name has been revised, the remaining 47 species are additions to our recorded fauna.

We have to give our grateful recognition to the skilled assistance rendered to us by Mr. E. A. Smith, of the British Museum; Mr. Chas. Hedley, Sydney; Dr. J. C. Verco and Mr. W. T. Bednall, Adelaide; and Mr. Robt. Hall and Mr. W. L. May, Tasmania.

We desire to state that we do not aim at giving every possible reference, or every synonym, but our endeavour has been to state the correct name that in each instance should be used for our shells. We only cite the author and date of a genus in cases where it has not been given previously.

Dr. W. H. Dall in 1904 published a paper entitled "An Historical and Systematic Review of the Frog-shells and Tritons" in vol. xlvii. of the Smithsonian Miscellaneous Collections. It deals with the matter in a masterly and comprehensive manner. His classification has been adopted by the British Museum, and also by the Australian Museum, Sydney; we therefore follow the same course, and in the present paper indicate the necessary changes that have in consequence to be made in the nomenclature of our shells.

Coralliophila rubrococcinea, Melvill and Standen.

1901. Coralliophila rubrococcinea, Melvill and Standen. P.Z.S. Lond., p. 401, pl. 21, f. 2.

Hab.—Port Fairy and San Remo.

Obs.—This is the species referred to in vol. x. of these proceedings, page 261, as being closely allied to *C. fritschi*, Martens.

CORALLIOPHILA ELABORATA, H. and A. Adams.

1863. Coralliophila elaborata, H. and A. Adams. P.Z.S. Lond., p. 433.

Hab.—San Remo and Lorne.

Obs.—This is the species referred to in vol. x. of these proceedings, page 262.

Family SEPTIDAE.

Genus Personella, Conrad, 1865.

PERSONELLA EBURNEUS, Reeve.

1898. Lotorium eburneum, Pritchard and Gatliff. P.R.S. Vic., vol. x., n.s., p. 265.

PERSONELLA VERRUCOOSUS, Reeve.

1898. Lotorium verrucosum, Pritchard and Gatliff. P.R.S. Vic., vol. x., n.s., p. 266.

Genus Eugyrina, Dall, 1904.

EUGYRINA SUBDISTORTUM, Lamarck.

1898. Lotorium subdistortum, Pritchard and Gatliff. P.R.S. Vic., vol. x., n.s., p. 263.

Genus Argobuccinum, Mörch, 1852.

ARGOBUCCINUM ARGUS, Gmelin.

1898. Lotorium (Argobuccinum) argus, Pritchard and Gatliff. P.R.S. Vic., vol. x., n.s., p. 267.

ARGOBUCCINUM BASSI, Angas.

1898. Lotorium bassi, Pritchard and Gatliff. P.R.S. Vic., vol. x., n.s., p. 263.

ARGOBUCCINUM AUSTRALASIA, Perry.

1906. Lotorium (Argobuccinum) australasia, Pritchard and Gatliff. P.R.S. Vic., vol. xviii., n.s., p. 42.

Genus Cymatium, Bolten, 1798.

CYMATIUM (GUTTURNIUM) PARKINSONIANUM, Perry.

1906. Lotorium parkinsonianum, Pritchard and Gatliff. P.R.S. Vic., vol. xviii., n.s., p. 42.

CYMATIUM (TURRITRITON) EXARATUM, Reeve.

1898. Lotorium exaratum, Pritchard and Gatliff. P.R.S. Vic., vol. x., n.s., p. 265.

CYMATIUM (CABESTANA), SPENGLERI, Chemnitz.

1898. Lotorium spengleri, Pritchard and Gatliff. P.R.S. Vic., vol. x., n.s., p. 263.

Genus Septa, Perry, 1811.

SEPTA RUBICUNDA, Perry.

1906. Lotorium rubicunda, Pritchard and Gatliff. P.R.S. Vic., vol. xviii., n.s., p. 41.

Genus Latirofusus, Cossman, 1889.

LATIROFUSUS SPICERI, T. Woods.

1876. Fusus spiceri, T. Woods. P.R.S. Tas., p. 137.
1891. Latirofusus nigrofuscus, Tate. T.R.S. S.A., vol. xiv., p. 258, pl. 11, f. 3.
1901. Latirofusus spiceri, Tate and May. P.L.S. N.S.W., vol. xxvi., p. 356.

Hab.—Dredged between Phillip and French Islands, Western Port.

Obs.—Also found in South Australia and King Island (type in Hobart Museum). It is a dark brown shell with a blackish epidermis. Size: Length 20, width 7 mm.

A shell nearly related to the above is *Latirus bairstowi*, Sowerby, from Port Elizabeth, South Africa, of which we have specimens before us.

CANTHARUS SUBRUBIGINOSA, E. A. Smith.

1879. Tritonidea subrubiginosa, E. A. Smith. P.Z.S. Lond., p. 206, pl. 20, f. 40.

1896. Tritonidea fusiformis, Verco. T.R.S. S.A., p. 219, pl. 6, f. 1, 1a, 1b.

Hab.—Portland (Maplestone); Ocean Beach, Point Nepean.

Obs.—One of us compared our shell with the type in the British Museum, and Mr. Smith stated it was his species. Dr. Verco has informed us that his species is conspecific.

VOLUTA MAMILLA, Gray.

1898. Voluta mamilla, Pritchard and Gatliff. P.R.S. Vic., vol. xv., n.s., p. 283.

1901. Voluta mamilla, Dautzenberg. Jour. d Conch., p. 10, pl. 2, f. 1.

Obs.—The above is a very fine figure, and it appears to be the first time that the adult form has been depicted.

MITRA STRANGEI, Angas.

1867. Mitra strangei, Ang. P.Z.S. Lond., p. 110 and p. 194.

1899. Mitra franciscana, Pritchard and Gatliff. P.R.S. Vic., vol. xi., n.s., p. 188.

1901. Mitra franciscana, Tate and May. P.L.S. N.S.W., p. 361, pl. 24, f. 30.

Hab.—Dredged living, Western Port, about 5 faths.

Obs.—Mr. W. F. Petterd states that he handed the shell to Rev. Tenison Woods, informing him that it was *M. strangei*, Ang., and he must have forgotten this fact when he re-named it, and our species has been compared by one of us with *M. strangei* in the British Museum, and they are the same.

MITRA CINERACEA, Reeve.

1907. Mitra cineracea, Gatliff. P.R.S. Vic., vol. xx., n.s., p. 31.

Obs.—This was included as a Victorian species, as the "Challenger" Report stated that it was dredged off East Moncoeur Island, Bass Straits. One of us inspected the only specimen

obtained by the "Challenger," which is now in the British Museum, and it was labelled habitat Philippines. Upon writing to Mr. E. A. Smith upon the matter, he replied, "I think Watson made a mistake in quoting this from East Moncoeur Island, Station 162. It should have been Station 212. See p. 717, of the 'Challenger' Report, where it is quoted under Philippines, but on p. 704, under E. Moncoeur Island, it is not mentioned."

Genus **Turris**, Montfort, 1810. Replacing *Turricula*, Klein, 1753 (pre Linnean).

TURRIS CINNAMOMEA, A. Adams.

1854. Volutomitra cinnamomea, A. Ad. P.Z.S. Lond. p. 134.

1901. Mitra cinnamomea, Tate and May. P.L.S. N.S.W., p. 361.

Hab.—Dredged living between Phillip and French Islands, Western Port, about 5 fath.; San Remo.

Obs.—One of us has examined this species at the British Museum, and ours is the same. It is of rare occurrence here.

MARGINELLA SIMSONI, Tate and May.

1884. Marginella minima, Petterd. Jour. of Conch., p. 144, non Sowerby, 1846.

1900. Marginella simsoni, Tate and May. T.R.S. S.A., vol. xxiv., p. 92.

1901. Marginella simsoni, Tate and May. P.L.S. N.S.W., vol. xxvi., p. 364, pl. 27, f. 95.

Hab.—Dredged living in about seven fathoms, between Phillip and French Islands, Western Port; Portsea, Port Phillip.

Obs.—This is a minute species, the type being described as being, "Long. $1\frac{1}{2}$ mil., lat. $\frac{3}{4}$ mil." We have obtained them varying in dimensions from this size up to length 2.9 mm., breadth 2 mm. In general appearance it approaches nearly to *M. shorehami*, Pritchard and Gatliff; but the latter has a more produced spire and wider aperture. In the reference last named Messrs. Tate and May also cite their figure 78, pl. 26, but this

represents a different species. In their former paper they place it as spec. nov., whereas it should have been stated to be nom. mut.

MARGINELLA MULTIPLICATA, Tate and May.

1900. Marginella multiplicata, Tate and May. T.R.S. S.A., vol. xxiv., p. 91.

1901. Marginella multiplicata, Tate and May. P.L.S. N.S.W., vol. xxvi., p. 364, pl. 27, f. 88.

Hab.—Shoreham, Western Port.

Obs.—A minute white shell. Length 1.6, width .95 mm. In general appearance resembling *M. cymbalum*, Tate.

MARGINELLA VICTORIAE, Gatliff and Gabriel.

1908. Marginella victoriae, Gatliff and Gabriel. P.R.S. Vic., vol. xxi., n.s., p. 365, pl. 21, f. 5.

Hab.—Dredged, Western Port. In shell sand, Portsea, Port Phillip.

COLUMBELLA LEGRANDI, T. Woods.

1876. Columbella legrandi, T. Woods. P.R.S. Tas., p. 152.

1883. Columbella legrandi, Tryon. Man. Conch., vol. v., p. 137, pl. 51, f. 49.

1899. Columbella brunnea, Pritchard and Gatliff. P.R.S. Vic., vol. xi., n.s., p. 203.

1901. Columbella legrandi, Tate and May. P.L.S. N.S.W., vol. xxvi., p. 367.

1902. Columbella legrandi, May. P.R.S. Tas., p. 110, Fig. 5 in text.

Hab.—San Remo; Ocean Beach, West Head, Flinders.

Obs.—An examination of the type proves that it and *C. brunnea*, Brazier, are the same species; the outer lip of the type is imperfect. In complete examples this is varicosely thickened.

COLUMBELLA (PYRENE) LURIDA, Hedley.

1907.—Pyrene lurida, Hedley. P.L.S. N.S.W., vol. xxxii., p. 510, pl. 17, f. 19.

Hab.—San Remo; Portsea; Torquay.

Obs.—A small, semi-translucent, brownish shell. Size of type, length 3.4, width 1.5 mm. Our specimens are rather narrower.

We are indebted to Mr. Hedley for the identification of this species.

CANCELLARIA PURPURIFORMIS, Valenciennes.

1841. Cancellaria purpuriformis, Valenciennes. In Kiener's Coq. Viv., No. 27, pl. 7, f. 4.
1855. Cancellaria purpuriformis, Sowerby. Thes. Conch., vol. ii., p. 448, pl. 95, f. 68 and 70.
1856. Cancellaria purpuriformis, Reeve. Conch. Icon., vol. x., pl. 16, f. 76.
1887. Cancellaria purpuriformis, Lobbecke. Conch. Cab., p. 88, No. 93, pl, 22. f. 9, 10.
1899. Cancellaria maccoyi, Pritchard and Gatliff. P.R.S. Vic., vol. xi., n.s., p. 182, pl. 20, f. 6.
1901. Cancellaria purpuriformis, Tate and May. P.L.S. N.S.W., vol. xxvi., p. 373.

Hab.—Western Port. Dredged living in about five fathoms, between Phillip and French Islands.

Obs.—An examination by one of us of the shell in the British Museum, named *C. purpuriformis*, Val., leads to the above conclusion, but their specimen is of a uniform pale yellow, and does not show the colour bands. Tate and May place *C. tasmanica*, T. Woods, as a synonym, and just above, on the same page, referring to C. laevigata, state, "*C. laevigata*, Sowerby, and *C. purpuriformis*, Reeve, in the Brit. Mus., are identical (R. Tate)."

TEREBRA ALBIDA, Gray.

1899. Terebra albida, Pritchard and Gatliff. P.R.S. Vic., vol. xi., n.s.. p. 207.

Hab.—Portsea, Port Phillip; Shoreham, Western Port.

Obs.—At the two localities named we have obtained specimens of this species, which exhibit small dark-brown spots on the shoulder of the whorl, numbering twelve to fourteen on the penultimate whorl. Previously we only knew of them being obtained of a uniform white.

DRILLIA ANGASI, Crosse.

1863. Drillia angasi, Crosse. Jour. de Conch., p. 87, pl. 1, f. 5.

Hab.—San Remo (Mrs. A. F. Kenyon).

DAPHNELLA LEGRANDI, Beddome.

1900. Clathurella legrandi, Pritchard and Gatliff. P.R.S. Vic., vol. xii., p. 178.

1900. Clathurella legrandi, Hedley. P.L.S. N.S.W., p. 509, pl. 25, f. 1-3.

1907. Daphnella sculptior, Hedley (non Clathurella sculptilior, T. Woods). Rec. Aust. Mus., vol. vi., p. 298.

Hab.—Portland; San Remo.

Obs.—The Rev. H. D. Atkinson kindly sent Mr. Gatliff two specimens of *C. sculptilior*, which were dredged by him at the same time as the shell that he gave to the Rev. T. Woods, which became the type. It is entirely distinct from *D. legrandi*. Mr. Gatliff also has a specimen of the latter species given to him by its author, and Mr. Hedley's figure above quoted is a good one.

Mr. Hedley gives *Daphnella bitorquata*, Sowerby, as a synonym, but we have not seen specimens bearing that name.

The type of *C. sculptilior* is not in the Hobart Museum, and Mr. W. L. May omits it from his list of T. Woods' types of the shells contained in that institution. After the original description the author remarks that his species comes close to *Clathurella sculptilis*, Angas, which is the next one following.

DAPHNELLA SCULPTILIS, Angas.

1871. Clathurella sculptilis, Angas. P.Z.S. Lond., p. 17, pl. 1, f. 19.

Hab.—Dredged between Phillip and French Islands, Western Port.

DAPHNELLA BASTOWI, Gatliff and Gabriel.

1908. Daphnella bastowi, Gatliff and Gabriel. P.R.S. Vic. vol. xxi., n.s., p. 365. pl. 21, f. 5.

Hab.—Dredged, Western Port.

CLATHURELLA ALBOCINCTA, Angas.

1871. Clathurella albocincta, Angas. P.Z.S. Lond., p. 18, pl. 1, f. 22.

Hab.—Port Albert.

Obs.—The size of the type is: Length 5., breadth 2. mm. It is a robust, coarsely sculptured species.

Genus Amauropsis, Mörch, 1857.

AMAUROPSIS GLOBULUS, Angas.

1880. Amauropsis globulus, Angas. P.Z.S. Lond., p. 416, pl. 40, f. 5.

Hab.—One dead specimen dredged in about five fathoms, between Phillip and French Islands, Western Port, San Remo (Mrs. A. F. Kenyon).

Obs.—A thin, brown, turbinate shell.

Genus Vermicularia, Lamarck, 1799.

VERMICULARIA FLAVA, Verco.

1907. Vermicularia flava Verco. T.R.S. S.A., vol. xxxi., p. 214, f. 1 in text.

Hab.—Dredged, Western Port.

Obs.—Dr. Verco has kindly sent us specimens, and from them we have been enabled to identify portions of the shell, which we have dredged, comprising the free tube.

ADEORBIS ANGASI, A. Adams.

1863. Adeorbis angasi, A. Adams. P.Z.S. Lond., p. 424, pl. 37, f. 11, 12.

Hab.—Portsea, Port Phillip.

Obs.—A small white shell. Diameter of type, 6 mm.

ADEORBIS KIMBERI, Verco.

1907. Adeorbis kimberi, Verco. T.R.S. S.A., p. 308, pl. 29, f. 1, 2.

Hab.—Shoreham, Western Port.

Obs.—A small translucent shell. Greatest diameter of type, 3.7 mm. May be distinguished from our other two species by its smoothness.

Genus Sirius, Hedley, 1900.

SIRIUS BADIUS, T. Woods.

1876. Raulinia badius, T. Woods. P.L.S. N.S.W., vol. ii., p. 264.

1900. Sirius badius, Hedley. Id., vol. xxv., p. 88, pl. 3, f. 8.

Hab.—San Remo (Mrs. Kenyon).

Obs.—The size of the specimen figured is: Length, 5 mm.

EULIMELLA TURRITA, Petterd.

1884. Aclis turrita, Petterd. Jour. of Conch., vol. iv., p. 140.

1901. Eulimella turrita, Tate and May. P.L.S. N.S.W., vol. xxvi., p. 384, pl. 25, f. 38

Hab.—Dredged off Portsea, Port Phillip.

Obs.—A small white translucent shell. Length of type 3, width 1 mm. Our single specimen is smaller.

ODOSTOMIA SIMPLEX, Angas.

1871. Odostomia simplex, Angas. P.Z.S. Lond., p. 15, pl. 1, f. 10.

Hab.—Dredged living, between Phillip and French Islands, Western Port.

CERITHIOPSIS TURBONILLOIDES, T. Woods.

1879. Bittium turbonilloides, T. Woods. P.R.S. Tas., p. 39.

1901. Cerithiopsis turbonilloides, Tate and May. P.L.S. N.S.W., vol. xxvi., p. 385, f. 6 in text.

Hab.—Dredged, Western Port.

Obs.—This species was incorrectly cited by Pritchard and Gatliff as being a synonym of *C. angasi*, O. Semper, the sculpture of which it strongly resembles. The specimens affording the diagnosis had, as is generally the case, imperfect apices. These differ in the two species.

Genus Pyrazus, Montfort, 1810.

PYRAZUS HERCULEUS, Martyn.

1784. Clava herculea, Martyn. Universal Conch., p. 13.
1900. Potamides ebeninus, Pritchard and Gatliff. P.R.S. Vic., vol. xiii., n.s., p. 156.
1906. Pyrazus herculeus, Hedley. P.L.S. N.S.W., vol. xxx., p. 529.

Obs.—Martyn's work is in the Commonwealth Parliamentary Library. Mr. Hedley, in his paper above quoted, enters fully into both the generic and specific names of the species, and figures the radula. He also gives other synonyms, but as they have not been in use here we refrain from quoting them.

TRIPHORA AMPULLA, Hedley.

1903. Triphora ampulla, Hedley. P.L.S. N.S.W., p.615, pl. 33, f. 38, 39.

Hab.—Portsea, Port Phillip.

Obs.—A small maculated shell, white and brown. Size: Length 5, width 1.6 mm.

DIALA MONILE, A. Adams.

1902. Diala monile, Pritchard and Gatliff. P.R.S. Vic., vol. xiv., n.s., p. 87.
1906. Diala monile, Hedley, P.L.S. N.S.W., for 1905, p. 523, pl. 33, f. 36.

Hab.—A littoral shell, coast generally, in suitable localities.

Obs.—Mr. Hedley has given the first figure of this species, as quoted above.

Genus Laevilitorina, Pfeiffer, 1886.

LAEVILITORINA MARIAE, T. Woods.

1900. Rissoa mariae, Pritchard and Gatliff. P.R.S. Vic., vol. xiv., n.s., p. 108.
1906. Laevilitorina mariae, Hedley. P.L.S. N.S.W., for 1905, p. 527.

Hab.—Coast generally.

Obs.—We always considered that this shell had been wrongly classed, and Mr. Hedley gives good reasons for his re-classification.

RISSOA (ONOBA) GLOMEROSA, Hedley.

1907. Onoba glomerosa, Hedley. P.L.S. N.S.W., vol. xxxii., p. 495, pl. 17, f. 23

Hab.—Port Albert (T. Worcester).

Obs.—A small, solid, columnar shell, three last whorls spirally striated, circular mouth; our single specimen is much larger than the type, being Length 4, width 1.5 mm.

RISSOA FRENCHIENSIS, nom. mut.

1877. Rissoa cyclostoma, T. Woods (non Recluz, 1843). P.R.S. Tas., p. 153.

1902. Rissoa cyclostoma, Pritchard and Gatliff. P.R.S. Vic., vol. xiv., n.s., p. 104.

Hab.—Dredged off French Island, Western Port, in about six fathoms; Port Phillip; Puebla Coast.

Obs.—We regret that we cannot follow the usual course and name this after its author, as the names R. woodsi and R. tenisoni are already in use.

RISSOINA RHYLLENSIS, Gatliff and Gabriel.

1908. Rissoina rhyllensis, Gatliff and Gabriel. P.R.S. Vic., vol. xxi., n.s., p. 367, pl. 21, f. 8.

Hab.—Dredged between Phillip and French Islands, Western Port; San Remo; Ocean Beach, Point Nepean.

PHASIANELLA NEPEANENSIS, Gatliff and Gabriel.

1908. Phasianella nepeanensis, Gatliff and Gabriel. P.R.S. Vic., vol. xxi., n.s. p. 366, pl. 21, f. 9, 10.

Hab.—Flinders, Western Port; Ocean Beach, Point Nepean.

CALLIOSTOMA AUSTRALIS, Broderip.

1835. Trochus australis, Broderip. Zool. Jour., vol. v., p. 331, pl. 49, f. 3.

1902. Calliostoma nobile, Pritchard and Gatliff. P.R.S. Vic., vol. xiv., n.s., p. 135.

Hab.—Shoreham and West Head, Western Port.

Obs.—We know of only two worn examples having been obtained on our shores, but have a very broad, equilateral specimen, got living at King Island, Bass Straits. Our specimens are not so broad as this, but are much broader than that figured as the type from Garden Island, Western Australia.

HALIOTIS CYCLOBATES, Pèron.

1816. Haliotis cyclobates, Pèron. Voy. Terre Aust., vol. ii., p. 80.

1903. Haliotis excavata, Pritchard and Gatliff. P.R.S. Vic., vol. xv., n.s., p. 180.

1906. Haliotis cyclobates, Hedley. P.L.S. N.S.W., vol. xxx., p. 520.

Hab.—Portsea, Port Phillip.

Obs.—See note on the following species.

HALIOTIS CONICOPORA, Pèron.

1816. Haliotis conicopora, Pèron. Voy. Terre Aust., vol. ii., p. 80.

1902. Haliotis granti, Pritchard and Gatliff. P.R.S. Vic., vol. xiv., n.s., p. 183, pl. 10, three figures.

1906. Haliotis conicopora, Hedley. P.L.S. N.S.W., vol. xxx., p. 520.

Hab.—Shoreham, Western Port.

Obs.—In the last paper, quoted above, Mr. Hedley calls attention to the two species of *Haliotis* recorded and named by Pèron, and obtained by the latter at Kangaroo Island, South Australia. His descriptions are very brief, but the distinctive specific differences are given in such a way that there is no doubt about the shells he refers to. As mentioned in the catalogue, *H. granti* has been obtained at Cape Northumberland, South Australia. Mr. Hedley states that the description of *H. conicopora* answers to that of *H. tubifera*, Lamarck. If this is the case, the latter being subsequent, becomes a synonym. Lamarck gives the habitat of his species as the seas of New Holland, but Deshayes and Edwards, in the third edition of Anim. S. Vert. place *H. tubifera* as a synonym of *H. gigantea*,

Chem. This is a Japanese shell, and we have never heard of it having been obtained in the seas of Southern Australia.

Specimens in the British Museum, examined by one of us, of *H. cunninghamii*, Gray,[1] lead to the conclusion that it is conspecific.

LUCAPINELLA OBLONGA, Menke.

1843. Fissurella oblonga, Menke. Moll. Nov. Holl., p. 33, No. 181.

1903. Lucapinella pritchardi, Pritchard and Gatliff. P.R.S. Vic., vol. xv., n.s., p. 184.

Hab.—Port Phillip; Western Port.

Obs.—Having received specimens from West Australia, and discussed the matter with Mr. Hedley, we now adopt his view that *L. pritchardi*, Hedley, is conspecific.

PUNCTURELLA DEMISSA, Hedley.

1904. Puncturella demissa, Hedley. Rec. Australian Mus., vol. v., p. 93, f. 19.

1907. Puncturella demissa, Hedley. Id., vol. vi., p. 289, pl. 54, f. 3-5.

Hab.—Dredged between Phillip and French Islands, Western Port.

Obs.—A small shell. Size: Height 1.5, length 2.5, breadth 0.9 mm. It has a black epidermis, the shell being white.

Genus **Cocculina**, Dall, 1882.

COCCULINA TASMANICA, Pilsbry.

1895. Nacella parva, Angas, var. tasmanica, Pilsbry. "Nautilus," p. 128.

1900. Nacella tasmanica, Tate and May. T.R.S. S.A., vol. xxiv., p. 102.

1901. Nacella tasmanica, Tate and May. P.L.S. N.S.W., vol. xxvi., p. 411, pl. 27, f. 89, 90.

1903. Cocculina meridionalis, Hedley. Mem. Aust. Mus., vol. iv., p. 331, f. 64, in text.

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1 King's Survey of Australia, vol. ii., p. 494.

Hab.—Shoreham, Western Port.

Obs.—A small white species.

ACMAEA COSTATA, Sowerby.

1903. Acmaea costata, Pritchard and Gatliff. P.R.S. Vic., vol. xv., n.s., p. 194.

1904. Acmaea alticostata, Hedley. P.L.S. N.S.W., vol. xxix., p. 189.

1907. Acmaea alticostata, Verco. T.R.S. S.A., vol. xxx., p. 209.

Hab.—Coast generally.

Obs.—We cannot agree with Mr. Hedley and Dr. Verco in regarding *A. alticostata* as a distinct species, because Mr. G. B. Sowerby informed one of us that he considered that it was conspecific with *A. costata,* Sowerby, and Mr. E. A. Smith, of the British Museum (where the type of *A. alticostata* is), said the same thing.

ACMAEA LATISTRIGATA, Angas.

1903. Acmaea gealei, Pritchard and Gatliff (non Angas). P.R.S. Vic., vol. xv., n.s., p. 197.

1907. Acmaea marmorata, Verco. T.R.S. S.A., vol. xxx., p. 210.

Hab.—Coast generally.

Obs.—The former identification was made from a specimen named incorrectly *A. gealei,* received from South Australia. An examination of the type of the latter in the British Museum proved it to be a distinct form. It is much worn, and most probably is conspecific with *A. flammea,* Quoy and Gaimard.

Genus **Helcioniscus**, Dall, 1871.

HELCIONISCUS DIEMENENSIS, Philippi.

1848. Patella diemenensis, Philippi. Zeit., f. Malak, p. 162.

1903. Patella tramoserica, Pritchard and Gatliff (non Martyn). P.R.S. Vic., vol. xv., n.s., p. 191.

Hab.—Coast generally.

Obs.—Our species has been generally known as *P. tramoserica*, Martyn, but he quotes north-west and north-east coast of America as the habitat of his species, and his figure does not represent the shell, which is abundant on our shores, although it shows great variation, and we have a fine series before us. Not one of them could be identified by Martyn's excellent figure; he gives no description. We therefore adopt the above name, which has hitherto been cited as a synonym. A copy of Martyn's work is in the Commonwealth Parliamentary Library.

HELCIONISCUS LIMBATA, Philippi.

1903. Patella limbata, Pritchard and Gatliff. P.R.S. Vic., vol. xv., n.s., p. 192.

Hab.—Wilson's Promontory; Cape Otway.

NACELLA CREBRESTRIATA, Verco.

1904. Nacella crebrestriata, Verco. T.R.S. S.A., vol. xxviii., p. 144, pl. 26, f. 20., 21.

Hab.—Portsea, Port Phillip. In shell sand.

Obs.—A small translucent species. Ours are usually suffused with a pink tint. Size of type: Length 3.8, breadth 2.1, height 1.8 mm.

LEPIDOPLEURUS CANCELLATUS, Sowerby.

1839. Chiton cancellatus, Sowerby. Conch. Ill., f. 104-5.

1847. Chiton cancellatus, Reeve. Conch. Icon., vol. iv., pl. 23, f. 152.

1892. Lepidopleurus cancellatus, Pilsbry. Man. Conch., vol. xiv., p. 3, pl. 3, f. 54-58.

Hab.—Dredged, Western Port.

Obs.—This species has a very wide distribution. Pilsbry citing, Britain, Greenland, Spain, Alaska and Korea. Mr. R. A. Bastow has critically compared our shell with *L. cancellatus*, received by him from Mr. Sowerby, which were obtained at Guernsey, and considers them conspecific. Our specimens are rather smaller.

ISCHNOCHITON SCULPTUS, Sowerby.

1840. Chiton sculptus, Sowerby. An. and Mag. Nat. Hist., vol. iv., p. 292.

1841. Chiton sculptus, Sowerby. Conch. Ill., No. 44, f. 66.

1847. Chiton sculptus, Reeve. Conch. Icon., vol. iv., No. 177, pl. 26, f. 121.

1892. Ischnochiton sculptus, Pilsbry. Man. Conch., vol. xiv., p. 92, pl. 23, f. 89-90.

Hab.—Ocean beach, Phillip Island; dredged in about eight fathoms in Western Port, between Phillip and French Islands, on dead oyster valves.

Obs.—When described the habitat was unknown, and we have not met with any record of it. Our examples range from 5 to 15 mm. in length. The sculpture somewhat resembles that of *Callistochiton antiquus*, Reeve.

ISCHNOCHITON ARBUTUM, Reeve.

1847. Chiton arbutum, Reeve. Conch. Icon., vol. iv., pl. 24, f. 162.

1892. Ischnochiton arbutum, Pilsbry. Man. Conch., vol. xiv., p. 139, pl. 24, f. 16, 17.

Hab.—San Remo (R. A. Bastow).

Obs.—A small variegated species. Length 9, breadth 5.7 mm.

ACANTHOCHITES (LOBOPLAX) VARIABILIS, Adams and Angas.

1864. Hanleya variabilis, Adams and Angas. P.Z.S. Lond., p. 194.

1893. Hanleya variabilis, Pilsbry. Man. Conch., vol. xv., p. 101.

1894. Acanthochites (Notoplax?) variabilis, Pilsbry. Proc. Acad. Nat. Sci. Philad., p. 84.

1897. Acanthochites (Loboplax) variabilis, Bednall. P. Malac. Soc. Lond., vol. ii., p. 156.

Hab.—Shoreham, Western Port.

Obs.—A small pustulated species, girdle covered with small white spicules, in tufts at the valve sutures.

RETUSA AMPHIZOSTUS, Watson.

1886. Utriculus amphizostus, Watson. Chall., vol. xv., p. 652, pl. 48, f. 11.

Hab.—Portsea, Port Phillip.

Obs.—Watson describes his species as being dredged in about seven fathoms, off Cape York, North Australia. Our shell is rather larger and more elongate, but we do not consider the slight difference has specific value.

BULLINELLA TENUIS, Hedley.

1905. Cylichna tenuis, Hedley. Rec. Aust. Mus., vol. vi., p. 54, f. 22.

Hab.—In shell sand, Ocean Beach, Point Nepean.

Obs.—This species was kindly identified for us by its author. The size of type is: Length 2.45, breadth 1.05 mm.

Genus Akera, Müller, 1776.

AKERA TASMANICA, Beddome.

(See this volume, Pl. XXI., Figs. 6, 7).

1883. Akera tasmanica, Beddome. P.R.S. Tas., p. 169.

1901. Hydatina tasmanica, Hedley. P.L.S. N.S.W., vol. xxv., p. 725, f. 22.

1901. Akera tasmanica, Tate and May. Id., vol. xxvi., pp. 417, 460.

Hab.—Shoreham, Western Port; Portsea, Port Phillip.

Obs.—A full description is given in the last reference quoted above, as follows:—"Shell globosely-oblong, imperforate, thin, hyaline. Colour, brown, darker-tinted posteriorly, with a narrow white band near the shoulder, and a wider one in the anterior-third. Last whorl inflated, equalling the total length of the shell, rounded at the shoulder; spire truncated, flush with the posterior margin of the last whorl, separated by a channelled suture, terminated by a hyaline bulbous nucleus. Aperture contracted above, enlarging anteriorly to the arched front; outer lip truncatedly angled posteriorly; columella arched, simple. Length 1.9, width 1.2 mm."

Some of our examples are of a uniform brown, upon others a median band is discernible of a lighter colour, otherwise they exactly tally with the description. Mr. May, from specimens sent to him, confirms our identification. Mr. Hedley's figure, quoted above, does not depict our shell, so we are now figuring it.

AKERA SOLUTA, Gmelin.

?1791. Bulla soluta, Gmelin. Syst. Nat., ed. xiii., p. 3434.

1850. Bulla (Akera) soluta, Sowerby. Thes. Conch., vol. ii., p. 572, pl. 21, f. 40.

1896. Akera soluta, Kobelt. Conch. Cab., p. 96, pl. 2, f. 20-22.

Hab.—San Remo (Mrs. A. F. Kenyon).

Obs.—This widely distributed species has been recorded as obtained on the coasts of New South Wales and South Australia.

CLAVAGELLA MULTANGULARIS, Tate.

1887. Aspergillum multangulare. Tate. T.R.S. S.A., vol. ix., p. 64, pl. 4, f. 4. a. b.

1892. Clavagella multangularis, Tate. Id., vol. xv., p. 134.

Hab.—Dredged living, about seven fathoms, between Phillip and French Islands, Western Port.

MYODORA ALBIDA, T. Woods.

1876. Myodora albida, T. Woods. P.R.S. Tas., p. 160.

1896. Myodora corrugata, Verco. T.R.S. S.A., vol. xx., p. 229, pl. 8, f. 1, 1a. 1b.

1901. Myodora albida, Tate and May. P.L.S. N.S.W., vol. xxvi., p. 422.

Hab.—Dredged between Phillip and French Islands, Western Port.

Obs.—A small fragile species, in shape resembling a *Thraciopsis*.

THRACIA LINCOLNENSIS, Verco.

1907. Thracia lincolnensis, Verco. T.R.S. S.A., vol. xxxi., p. 229, pl. 28, f. 19-21.

Hab.—Frankston, Port Phillip.

Obs.—A small white shell. Size of type: Antero-posterior, 7.3 ; umbo-ventral, 5.1 mm.

SOLETELLINA BIRADIATA, Wood.

1903. Soletellina biradiata, Pritchard and Gatliff. P.R.S. Vic., vol. xvi., n.s., p. 114.

1907. Soletellina hedleyi, Sowerby. Proc. Mal. Soc. Lond., vol. vii., p. 302, pl. 25, f. 12.

Hab.—Port Phillip.

Obs.—Mr. Sowerby is right in stating that the above shell had long passed muster in Australian collections for *Sanguinolaria vitrea*, Desh. Pritchard and Gatliff discovered the error when dealing in their catalogue with *Soletellina biradiata*, Wood, of which species the shell described as *S. hedleyi* is the young form.

TELLINA SUBDILUTA, Tate.

1887. Tellina subdiluta, Tate. T.R.S. S.A., vol. ix., p. 65. pl. 4, f. 9.

Hab.—Dredged off Stony Point, Western Port; one valve.

VENERUPIS OBESA, Deshayes.

1853. Venerupis obesa, Deshayes. P.Z.S. Lond., p. 5.

1854. Venerupis obesa, Sowerby. Thes. Conch., vol. ii., p. 767, pl. 164, f. 15.

1874. Venerupis obesa, Reeve. Conch. Icon., vol. xix., pl. 3, f. 13.

1903. Venerupis sp., Pritchard and Gatliff. P.R.S. Vic., vol. xvi., n.s.. p. 121.

Hab.—Portarlington and Portsea, Port Phillip.

Obs.—At the reference last quoted it was stated that our shell was comparable with *V. obesa.* Additional specimens have since been obtained, and upon comparison by one of us, prove to be the same as a single specimen at the British Museum bearing that name. The locality of it is given as Port Phillip.

Genus Cyamiomactra, Bernard, 1897.

CYAMIOMACTRA MACTROIDES, Tate and May.

1904. Cyamium mactroides, Pritchard and Gatliff. P.R.S. Vic., vol. xvii., n.s., p. 228.

1906. Cyamiomactra mactroides, Hedley. P.L.S. N.S.W., vol. xxx., p. 541, pl. 31, f. 9, 10.

Hab.—Portsea, Port Phillip; Western Port; Port Albert.

Cyamiomactra communis, Hedley.

1906. Cyamiomactra communis, Hedley. P.L.S. N.S.W., vol. xxx., p. 541, pl, 31, f. 11-13.

Hab.—Port Fairy.

Genus Legrandina, Tate and May, 1901.

Legrandina bernardi, Tate and May.

1901. Legrandina bernardi, Tate and May. P.L.S. N.S.W., vol. xxvi., p. 433 and 463, pl. 27, f. 98, 99.

Hab.—Port Albert (T. Worcester).

Obs.—Externally this shell resembles *Cyamiomactra.* We sent specimens for examination to Mr. W. L. May, to ascertain if it was the above species. In his reply he remarks: "Undoubtedly *L. bernardi,* only they are much more, or perhaps quite adult, whilst our typical lot I now consider to be very immature. The older shell causes the hinge to be much stronger and more easily seen than in the type."

Genus Neolepton, Monterosato, 1875.

Neolepton sanguineum, Hutton.

1884. Kellia sanguinea, Hutton. Trans. New Zealand Inst., vol. xvi., for 1883, p. 215.

1904. Neolepton sanguineum, Hutton. Index Faunae Nov. Zealandiae, p. 92.

Hab.—Torquay; Ocean Beach, Point Nepean.

Obs.—A small orbicular shell. Our identification is made from specimens kindly sent by Mr. H. Suter, New Zealand.

Neolepton antipodum, Filhol.

1880. Kellya antipodum, Filhol. Compt. Rend. Acad. Sci., vol. xci., p. 1095.

1897. Neolepton antipodum, Bernard. Bull. Mus. d' Hist. Nat., vol. vii., p. 314.

1906. Neolepton antipodum, Hedley. Trans. New Zealand Inst., vol. xxxviii., for 1905, p. 73, pl. 1, f. 5.

Hab.—Dredged off Portsea, Port Phillip; Ocean Beach, Point Nepean.

Obs.—A small concentrically ridged shell. Size: Height 1.9, length 2.1 mm.

NEOLEPTON ROSTELLATUM, Tate.

1904. Kellia rostellata, Pritchard and Gatliff. P.R.S. Vic., vol. xvii., n.s., p. 225.

1906. Neolepton rostellatum, Hedley. P.L.S. N.S.W., vol. xxx., p. 542, pl. 21, f. 3, 4.

1907. Neolepton rostellaum, Verco. T.R.S. S.A., p. 106.

Hab.—Ocean Beach, Point Nepean.

Genus Ephippodonta, Tate, 1889.

EPHIPPODONTA LUNATA, Tate.

1887. Scintilla (?) lunata, Tate. T.R.S. S.A., vol. ix., for 1886, p. 69, pl. 4, f. 8.

1889. Ephippodonta lunata, Tate. T.R.S. S.A., vol. x., p. 63.

Hab.—San Remo (Mrs. A. F. Kenyon).

Obs.—One valve only obtained.

CONDYLOCARDIA OVATA, Hedley.

1906. Condylocardia ovata, Hedley. P.L.S. N.S.W., for 1905, p. 539, pl. 31, f. 5, 6.

Hab.—Dredged between Phillip and French Islands, Western Port.

Obs.—A small white translucent shell, with slight concentric ridges. Size: Height 1.35, length 1.55 mm.

Genus Anadara, Gray, 1847.

ANADARA TRAPEZIA, Deshayes.

1904. Barbatia trapezia, Pritchard and Gatliff. P.R.S. Vic., vol. xvii., n.s., p. 242.

1904. Arca lischkei, Hedley (non Dunker). P.L.S. N.S.W., vol. xxix., p. 203, pl. 9, f. 29-34.

1907. Anadara trapezia, Lamy. Jour de Conch., vol. lv., p. 246.

Hab.—Dredged living, Western Port.

Obs.—In his Revision of the Arcidae, Mr. Lamy, in a foot-note, page 243, quotes Mr. Hedley's paper, but he does not appear to adopt the conclusions therein set forth.

Genus **Lissarca**, E. A. Smith, 1879.

LISSARCA RHOMBOIDALIS, Verco.

1907. Lissarca rhomboidalis, Verco. T.R.S. S.A., vol. xxxi., p. 221, pl. 27, f. 7.

Hab.—Dredged between Phillip and French Islands, Western Port.

Obs.—A small, translucent, horn-coloured shell of the shape indicated by its name. Size: Height 2, length 2.4 mm.

LISSARCA RUBRICATA, Tate.

1904. Limopsis rubricata. Pritchard and Gatliff. P.R.S. Vic., vol. xvii., n.s., p. 246.

1907. Lissarca rubricata, Verco. T.R.S. S.A., vol. xxxi., p. 221.

Hab.—Portsea, Port Phillip; Torquay; dredged, Western Port.

Obs.—Those obtained living in the last named locality are usually of a uniform red colour, but were identified by Prof. Tate as being his species. In the first reference given above it was mentioned that the generic classification was unsatisfactory. That opinion has received confirmation by the alteration that has been made, with which we agree.

LISSARCA PICTA, Hedley. Var.

1899. Austrosarepta picta, Hedley. P.L.S. N.S.W., p. 430.

1907. Lissarca picta, Lamy. Jour. de Conch., vol. lv., p. 291.

Hab.—Dredged, Western Port.

Obs.—One valve only was found, and kindly identified for us by Mr. Hedley as a variety of his species. In a foot-note at the

reference last above quoted it is stated that a letter has been received from Mr. Hedley, re-classifying the shell.

GLYCIMERIS FLABELLATUS, T. Woods.

1904. Glycimeris flabellatus, Pritchard and Gatliff. P.R.S. Vic. vol. xvii., n.s., p. 242.

——. Pectunculus pectinoides, Chenu (non Deshayes). Illus. Conch., vol. iii., pl. 2, f. 2.

1907. Glycimeris pectinoides, Verco (non Deshayes). T.R.S. S.A., vol. xxxi., p. 226, pl. 28, f. 4.

Hab.—Portland; Lakes Entrance.

Obs.—At the reference above quoted Dr. Verco considers our species as being the same as *Pectunculus pectinoides*, Deshayes. Cuvier Regn. Anim. (Fortin and Masson's illustrated edition), Mollusques, pl, 87, f. 8. There is no copy of this work in South Australia, but our Museum Library possesses one—it does not bear the date of publication—to which we have referred. Judging from it, we are unable to agree with our species being the same as *P. pectinoides*, Deshayes. The shell there figured has radiating ribs all curving to the posterior side. In our shell they radiate almost equally from the centre of the umbones to either side. Chenu's figure does not quite represent the shell as we find it, but Dr. Verco states that it cannot be distinguished from a half-grown example as found by him in South Australia. When consulting Chenu's work we were unable to find any date to it.

Genus Modiolarca, Gray, 1847.

MODIOLARCA TASMANICA, Beddome.

1883. Modiolarca tasmanica, Beddome. P.R.S. Tas., for 1882, p. 168.

1901. Modiolarca tasmanica, Tate and May. P.L.S. N.S.W., vol. xxvi., p. 439, fig. 12 in text, and p. 462.

Hab.—Found, living, on seaweed, Portsea, Port Phillip; Portland.

Obs.—A small brown shell. Size of type: Length 3, breadth 4, height 2.5 mm.

[PROC. ROY. SOC. VICTORIA, 21 (N.S.), PT. I., 1908].

ART. XIV.—*On the Occurrence of the Genus Linthia in Victoria, with description of a new species.*

BY G. B. PRITCHARD, B.Sc. F.G.S.,

Lecturer on Geology &c., Working Men's College, Melbourne.

(With Plates XXII., XXIII.).

[Read 11th July, 1908].

For several years the occurrence of a gigantic species of echinoderm in the Batesford Limestone, Geelong, has been known to me by abundant fragments and imperfect portions of a very large test. In 1890 I obtained an entire but very badly crushed example, which, together with the previously obtained fragments, was then regarded as *Pericosmus gigas*, McCoy, and was recorded as such from the above locality, in a paper on the Geology of the Southern Portion of the Moorabool Valley.[1]

This record should now be expunged, for more recently I obtained the largest and most perfect example I have yet seen, and careful examination of this shows it to belong undoubtedly to the genus *Linthia*, and not to *Pericosmus*. The late Sir F. McCoy records[2] *Pericosmus gigas* from Corio Bay, Geelong, but the specimen as preserved in the National Museum, Melbourne, being very imperfect and badly broken, shows a good deal of the matrix, and unfortunately no such matrix is known to occur at Corio Bay.

It is possible that this specimen may have come from the Batesford Quarries, and if such should have been the case, it is likely that *Pericosmus gigas*, as well as the large new species of *Linthia* herein described, may have existed in the same locality.

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1 Proc. Roy. Soc. Vic., vol. iv., n.s., pt. i., p. 18.
2 Prod. Pal. Vic., dec. vii., p. 16, pls. 64, 65.

Until recently the only Australian Older Tertiary record of *Linthia* was that of Professor R. Tate, in 1885,[1] when he attached the name of *Linthia antiaustralis* to an echinoid from the River Murray Cliffs, near Morgan.

In his revision of our echinoids in 1891[2] this was still the only species known. *Linthia* has recently been recorded[3] from Victoria, when the above Murray Cliffs fossil, *L. antiaustralis*, Tate, has been referred to as occurring at Curlewis, near Geelong.

In order to make the present description as complete as possible, I have thought it as well to include a full description of the generic characters as given by Professor Martin Duncan in his Revision of the Echinoidea.[4]

Genus Linthia, Merian, 1853.

Test variable, small to large, oval or cordiform, grooved anteriorly, subacuminate or truncated posteriorly, tumid and gibbose dorsally, almost flat actinally. Apical system small, excentric in front; four perforated basal plates; the madreporite separating the posterior basal plates and also the posterior radial plates.

Ambulacra diverse; the anterior in the broad groove, the pores round and small, the antero-lateral long, with the petaloid parts in grooves,, moderately long, divergent, pairs of pores, equal or subequal, nearly closing distally; postero-lateral ambulacral petals also in sunken grooves, less divergent and shorter than the others. Ambulacra forming the greater part of the peristomial margins, and moderately broad on either side of the sternum. Peristome excentric in front, semilunar, with well-developed posterior labrum. An amphisternum; the second plates of both of the zones of the right posterior ambulacrum united, so as to produce ancient heteronomy. Periproct at the upper part of the posterior truncation.

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1 Southern Science Record, vol. i., n.s., No. 1, Jan., 1885.

2 Trans. Roy. Soc. S.A., vol. xiv., pt. ii., p. 277.

3 F. Chapman, Victorian Fossils, pt. ix., 1908; Proc. Roy. Soc. Vic., vol. xx., n.s., pt. ii., p. 215, pl. xix., f. 1, 2, 3.

4 Jour. Lin. Soc. Lond., Zool., vol. xxiii., 1891, p. 233.

A peripetalous fasciole entering the interradia, a lateral fasciole starting from the peripetalous close to the antero-lateral ambulacra and passing beneath the periproct.

Tubercles crowded, largest actinally, usually crenulate and perforate, and either on flat or in sunken scrobicules.

I.—Linthia mooraboolensis, sp. nov.

(Pl. XXII., Figs. 1, 2; Pl. XXIII., Figs. 3, 4).

Description.—The test is very much depressed, and quite as tumid post-medially on the base or actinal surface, as behind the apex on the abactinal surface, becoming relatively much more flattened towards the anterior margin. The marginal contour is circular to very slightly elliptical, there usually being a little greater length in the antero-posterior diameter; deeply but narrowly grooved in front, where the odd anterior ambulacrum runs, and the groove is not of uniform width, having its maximum width about midway between the apical system and the anterior margin, and its minimum width, which is about one-third of the maximum, at one-fourth of this distance from the anterior. The anterior groove indents the margin to the extent of one-tenth of the antero-posterior diameter.

Upper surface very slightly convex, greatest convexity in the posterior interambulacrum, but not strikingly keeled.

Seen in lateral profile the maximum height of the test is situated at one-third the diameter from the posterior margin, abactinally gradually sloping to the anterior and posterior, actinally almost flat to the peristome, but running up at very low angle to the periproct.

The transverse profile is biconvex, more regular dorsally, but ventrally flattening towards the ambitus, which in consequence is not very tumid, but rather suddenly rounded.

Sternum convex, broadly lanceolate, well defined laterally by the posterior ambulacra, with two strong posterior tumidities, between which a shallow groove runs up to the elliptical periproct, the latter being obliquely set immediately below the margin. Peristome large, semilunate, eccentric to the front, and very close to the anterior notch, with a strongly swollen

posterior labrum. Ambulacra petaloid, unequal, narrow, but deeply sunken, anterior pair (70 mm. in the type) longer than the posterior pair (55 mm.), the anterior pair showing an angle of divergence of 125 degrees, whilst the posterior pair diverge at an angle of 50 degrees, all showing a slight forward curvature at their extremities. The odd anterior ambulacrum shallow at first, then broadening and deepening, then further deepening and narrowing owing to the overhanging and closely approaching margins.

Pores conjugate, upper series usually ovate, whilst the lower series are sometimes more nearly circular or only slightly elliptical, each ambulacral plate being perforated very near its lower suture; between thirty and forty pairs of pores exist in each poriferous zone, the smaller number being in the posterior petals.

The tubercles are remarkable in this species for their extreme fineness, very minute mammillation, and uniformity on the greater part of the abactinal surface, becoming a little coarser towards the anterior notch. The sternum is medially finely tuberculate, but becomes much more coarsely sculptured towards the posterior ambulacral plates, between the latter and the ambitus the coarsest tubercles occur, and these also show a marked increase in size towards the front margin.

Tubercles perforate, scrobiculate, and the coarser on the base faintly crenulate, abactinal tubercles a little obliquely and backwardly directed, the boss usually being eccentric on the scrobicule, which has the appearance of a flat surface, and very minute granules or miliaries surround the outside of the scrobicule.

Finest scrobicules run three in 2 millimetres, while the coarsest are of about 1 millimetre in diameter, and the coarsest tubercle is not more than half a millimetre in diameter.

There is a well developd but narrow (width, 1 mm.), and very sinuous peripetalous fasciole, which margins very close up to the petals; a still narrower (about .5 mm.) lateral fasciole starts from the peripetalous fasciole just a little behind and above the end of the antero-lateral petal, runs gradually towards the margin, then parallel with it for a distance before dropping below the margin, and apparently dips under the anus, but the

latter portion of its course is not absolutely distinct in the specimens before me.

Dimensions.—Longitudinal diameter, 195 millimetres; transverse diameter, 185 mm.; height, 55 mm.; Periproct, 20 mm. by 15 mm.; Peristome, 23 mm. by 4 mm.; thickness of test, 2 mm.

Locality.—Polyzoal Limestones of the Filter Quarries, Batesford, Moorabool Valley.—Balcombian—Eocene.

Observations.—In this species one is struck by the very large size associated with a comparatively thin and weak test, and this no doubt accounts for the large number of fragments or crushed specimens obtainable as against perfect examples, which have hitherto been very rare. This form appears to be one of the largest, if not the largest, species of the genus; but I am not in a position to assert positively on this point, as I have not yet had access to all the described species.

From *Pericosmus gigas*, McCoy, which, by the way, is also referable to the genus *Linthia*, the present species differs in its much more depressed form, its profile views being very distinctive, the anterior notch shows many divergent features, the ornamentation is of a much finer character, the tubercles are not so ornate, the fascioles are narrower and follow a rather different course, and the anterior petals diverge at a much smaller angle, and the poriferous plates are more crowded. The proportion of height to length in *P. gigas* is given as 45 : 100, whilst in the present species it is only 28.2 : 100.

II.—Linthia gigas, McCoy, sp.

1882. Pericosmus gigas, McCoy. Prod. Pal. Vic., Dec. vii., pp. 15, 16, plates 64, 65.

1892. Pericosmus gigas, Hall and Pritchard. Proc. Roy. Soc. Vic., vol. iv., n.s., pt. 1, p. 18.

1892. Pericosmus gigas, Pritchard. Ann. Report South Aust. School of Mines and Industries, p. 185.

Observations.—The original records of the occurrence of this species have unfortunately been of a somewhat ambiguous nature. The type was indicated by McCoy as from the banks

of the Murray, near its junction with the Darling, but those who know this locality have very grave doubts about its correctness. Then, again, Corio Bay is given as a locality, but the specimen preserved in the National Museum is certainly not in Corio Bay matrix, and it seems probable that the locality should have been Batesford.

Professor Tate[1] in his treatment of our echinoids only repeats McCoy's original localities, and nothing is added to our knowledge by Dennant and Kitson's Catalogue,[2] while the latest is a very doubtful record on fragmentary remains of a very large echinoid from near the junction of the Grange Burn and Muddy Creek, Western Victoria, by Mr. F. Chapman.[3]

Having regard to the characters of this echinoid, there seems very little doubt but that McCoy's species is better placed in the genus *Linthia*, and McCoy himself was not absolute in placing it as a *Pericosmus*, for he states: "I refer the fossil provisionally to *Pericosmus* as an aberrant species." The imperfect remains recorded by Mr. Chapman from our Western District are referred to as probably *Linthia gigas*.

In transferring this large species of echinoid to the genus *Linthia*, the possibility of the foregoing new species herein described, being only a form of *L. gigas*, has not been lost sight of, especially when one finds such enormous variability in all our echinoid species, which can be collected in large numbers. Still the characters in the specimens hitherto obtained of the new species appear to run along sufficiently divergent lines to warrant a distinctive name.

Linthia gigas may be characterised by being a very large convexly rounded species with strongly swollen ambitus, very widely divergent anterior-lateral petals, which are distinctly sigmoidal, in general shape somewhat ovate, and nearly half as high as long.

III.—Linthia antiaustralis, Tate.

1885. Linthia antiaustralis, Tate. Southern Science Record, vol. i., n.s., No. 1, January, pp. 4, 5.

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1 Trans. Roy. Soc. S.A., 1891, vol. xiv., pt. ii., p. 277.
2 Rec. Geo. Surv. Vic., vol. i., pt. ii., p. 131.
3 Proc. Roy. Soc. Vic., 1908, vol. xx., n.s., pt. ii., p. 217.

1908. Linthia antiaustralis, Chapman. Proc. Roy. Soc. Vic., vol. xxii., n.s., pt. 2, pp. 215, 216, plate xix., f. 1, 2, 3.

Observations.—This species had not been recognised as occurring in Victoria until a recent publication by Mr. Chapman, when Curlewis, near Geelong, is given as its locality, though the specimen was apparently collected by Mr. Daintree as early as 1861. Professor Tate's original particulars concerning this species are of the most meagre description, and failing a close and critical comparison, either with the type, or with *Linthias* of similar dimensions from the type locality, it seems to me well nigh impossible to make a certain identification. Professor Tate gives no figure of this species, but gives the dimensions as: Diameters of the base 60 mm. and 50 mm., and height 40 mm. Mr. Chapman figures the Curlewis specimen without any further descriptive particulars or dimensions, but notes in his explanation of the plate that the figures are natural size.

Figure 1 measures in length, 44 mm.; height, 27 mm. Figure 2, length, 42 mm.; width, 37 mm. Figure 3, length, 45.5 mm.; width, 39 mm.

These figures represent the profile, the dorsal view, and the ventral view respectively, but do not appear to show a very accurate agreement, and hardly seem close enough to Tate's particulars to admit of absolute certainty in the matter of this identification. With discrepancies of this kind and poor reproduction, it is little wonder that photographic reproduction of echinoids is strongly objected to in certain quarters.

I am quite aware that it is no easy matter to get good accurate photographs, and then again to follow that up by equally good reproduction; but at any rate every precaution should be taken to start well. For the sake of argument, suppose that this Curlewis echinoid does not prove to be Tate's Murray Cliffs species, then, what have we got? First a very poor original description, then figures which do not represent it, and of course many workers would be likely to look at the figures first, and we have a highly interesting position for a young student.

Such difficulties do present themselves occasionally, but surely it should be our very best endeavour to avoid the possibility of such confusion for the sake of subsequent investigators.

IV.—Linthia nelsoni, McCoy, sp.

1882. Pericosmus nelsoni, McCoy. Prod. Pal. Vic., Dec. vii., pp. 17-19, pl. 66, f. 1, 2, and pl. 67, f. 1.

1891. Pericosmus nelsoni, Tate. Trans. Roy. Soc. S.A., vol. xiv., pt. 2, p. 277.

Observations.—This species which, so far as I am aware, has only been collected from the Waurn Ponds quarries, which are situated about seven miles west of Geelong, appears on examination to require its removal from the genus *Pericosmus* to *Linthia.* All the characters of my specimens agree absolutely with those of *Linthia,* and also with McCoy's description of the above species, with the exception of the courses of the fascioles. In my examples there is a distinct and complete peripetalous fasciole, and a latero-sub-anal fasciole, which starts from the peripetalous a little above and behind the end of the anterior lateral petal. McCoy figures a basal view (plate 66, f. 2), which is very misleading in its anterior and posterior aspect. Through the courtesy of Mr. F. Chapman I have been able to examine McCoy's type and figured specimens, in addition to other examples, preserved in the National Museum, Melbourne. I was very much surprised to find McCoy's original material in such an imperfect state, and so poorly preserved, and this no doubt accounts for the discrepancies which appear to exist. On plate 66, figure 1, the posterior dorsal keel is abnormally flattened owing to crushing, whilst it is really distinctly angularly keeled in perfect specimens.

Plate 66, figure 2, shows the base of another crushed specimen, but I was unable to detect the anterior portion of the peripetalous fasciole in the position as figured; it is just discernible on the front margin, but could not be visible in the view as shown, unless the artist's licence goes so far as to permit, first, a tipping up of the posterior end to include a view of the periproct, and then a similar treatment for the front of the test, to include as much character as possible.

Figure 1, on plate 67, is wrong in its fasciole track, for while one side of this specimen is somewhat obscure, the other distinctly shows the lateral fasciole running up to and joining

the peripetalous at the rear, and a little above the end of the anterior lateral petal.

The anterior notch and the space where the odd anterior ambulacrum is lodged may be rather deeper, and the other petaloid ambulacra may be more sunken than indicated by McCoy in his description.

EXPLANATION OF PLATES.

Plate XXII.

Fig. 1.—Linthia mooraboolensis, sp. nov. Abactinal view.
„ 2.—Id. Longitudinal profile.

Plate XXIII.

Fig. 3.—Linthia mooraboolensis, sp. nov. Actinal view.
„ 4.—Id. Profile from the front.

Note.—All the figures are much reduced, the actual specimen figured being a little over 7½ inches in its greatest diameter.

END OF VOLUME XXI., PART I.

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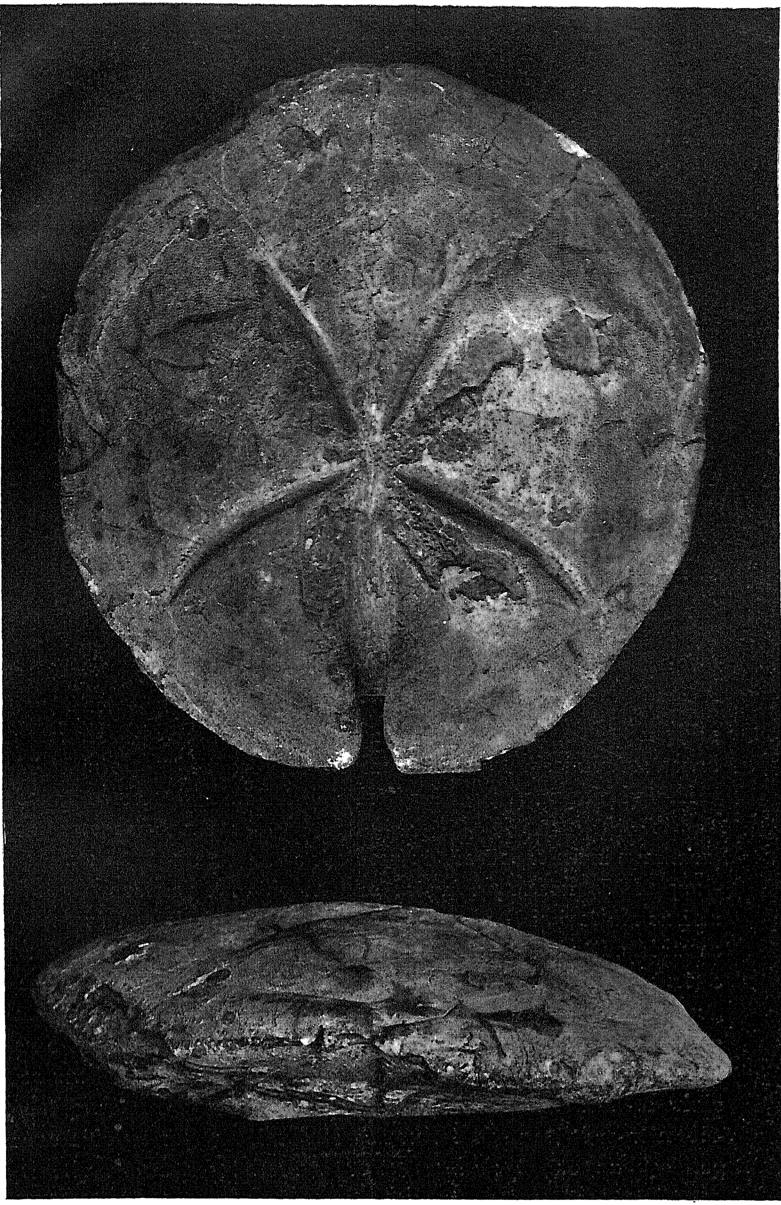

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THE AUTHORS OF THE SEVERAL PAPERS ARE SEVERALLY RESPONSIBLE FOR THE SOUNDNESS OF THE OPINIONS GIVEN AND FOR THE ACCURACY OF THE STATEMENTS MADE THEREIN.

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ART. XV.—*On the Structure of Hologlœa dubia, an Organism of doubtful affinity.*

BY BALDWIN SPENCER, M.A., C.M.G., F.R.S.,

Professor of Biology in the Melbourne University.

(With Plates XXIV., XV.).

[Read 10th September, 1908.]

In February, 1905, Dr. T. S. Hall collected at Lorne, on the shores of the southern coast of Victoria, a few specimens of a small organism that had evidently been thrown up during heavy weather in Bass Strait. From that time to this no further specimens have been obtained. Dr. Hall was unable to preserve many, and the fourteen that he did secure were preserved in formalin, and remained unnoticed until recently in the store collections of the Biological Laboratory in the Melbourne University.

The general appearance of the organism suggested at first glance an alliance with the Ctenophora, but what appears on superficial examination to be of the nature of ctenophoral bands turn out, on minute examination, to have nothing whatever to do with these, and not to possess the slightest trace of ctenophoral plates or canals.

I thought at one time that the organisms might be detached parts of some larger form—specially modified individuals of some colonial animal—but careful search reveals no trace of any such separation having taken place, and I can only conclude, therefore, that they represent a stage in the life history of some form which is at present unrecognised; possibly, as will be seen later, a nurse stock.

Their structure is at once simple, definite and remarkable, and, in certain respects, quite unlike that of any organism at present described.

Each has taken the form of a mass of stiff jelly with four sides and an oral and aboral end. (Figs. 1, 2, 3, 4.) Every

margin is bounded by a very distinct band of finely punctated material that stands out clearly as a light band when the organism is viewed against a dark background. For the purpose of convenience in reference, I have numbered the lateral margins of the quadrangular mass, 1, 2, 3 and 4.

In Figure 1 is seen a general view of the organism. It is quite transparent, and by careful focussing under a low power the whole of the structure of the body can be seen. Figure 1 represents a side view, Figure 3 a view of the oral surface, and Figure 4 a diagrammatic transverse section. The dimensions of the largest specimen are as follows, but there is very little variation in size amongst them. Distance between oral and aboral surfaces, 11 mm.; width between margins 1 and 3, 9 mm.; downward projection of margin 1, 2.5 mm.

General Form.—When the animal is alive the body is probably a fairly regular, quadrangular shaped mass of stiff jelly. The mouth lies in the middle of the oral surface, and leads into a simple, wide, flask-shaped cavity occupying the centre of the jelly mass. From the central point of its distal end there arises a very small but distinct tube which runs up to, and opens on a conical projection on the aboral surface. (Fig. 2.)

The margin numbered 1 (Figs. 1 and 5) is prolonged beyond the oral surface so as to form a conical projection, the three sharply marked edges of which are serrated. The surface that lies between the margins 1 and 2 (Figs. 1, 2, 4 and 5) is indented by a deep groove which penetrates the jelly almost as far as, but not quite to, the central tubular cavity. On the aboral surface the jelly is lifted up (Fig. 2) to form a conical projection, which is cut through by the groove, into which, at its upper end, the small tube from the central cavity opens. The groove, which forms one of the most remarkable features of the organism, is a very definite structure, and extends to within a short distance of the oral surface. Except at the aboral end its lips are close together. At the oral end one lip is continued (Fig. 5) as a well-defined line of densely punctated material, precisely similar to that of the margins, marked with ten or eleven serrations. It passes down, curving gracefully on to the aboral projection already described, the groove not extending so far as its termination.

Structure of Body Wall.—One of the most striking features is the entire absence of any cellular structure on the surface of the body. When stained with Haemalum or Picro-carmine, transverse sections cut with the freezing microtome[1] showed, except along the marginal lines, only a homogeneous jelly extending from the central cavity to the surface, without a trace of a cell either in the jelly or on the external surface. Preparations were made of four specimens, with precisely the same result in each case. It is, of course, possible, but scarcely probable, that every vestige of cellular structure, supposing such to have once been present on the surface, may have been rubbed off. The otherwise very definite and in all cases similar form and appearance of the outside surface of the fourteen specimens seem to indicate that this remarkable structure, or rather absence of structure, is characteristic of the organism.

As already said, the margins are very definitely modified. Against a dark background they stand out white. In some cases they are slightly broken and discontinuous, but as a general rule they are regular. On the surface of each is a very definite cuticular layer, sharply marked by reason of the fact that it does not, or at most only slightly, take stain. On the oral projection, and also in some cases on the lower parts of the other marginal lines and around the margins of the oral surface the cuticle is distinctly serrated. (Figs. 5 and 5a.) Each serration has a core of material that slightly takes stain. On either side of the marginal lines the cuticle merges into the general outer layer of the jelly, which sometimes has the appearance of being slightly modified as if to form a thin cuticle over the jelly mass. Beneath the cuticle of the marginal lines lies a band of very finely punctated material, but beyond these punctations, which are densest close beneath the cuticle, not a trace of structure can be detected. There are no cilia, no ctenophoral plates, and no canals.

The terminal curved and serrated lip of one side of the groove (Fig. 5) has the same structure as the marginal lines.

The Central Canal.—The central tubular cavity, with the aboral canal and certain structures associated with them, are

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1 I am indebted to the kindness of Mr. W. Fielder for cutting these sections for me.

the only parts where any cellular structure can be detected. The central tube functions, presumably, as an alimentary canal. Its oral opening is just a simple round hole in the jelly, and from this a flask-shaped tube, gradually increasing in size, extends upwards for about four-fifths of the length of the jelly mass (Al. 1). From the centre of the aboral end a small but very definite canal arises, and from the same point four bands take their origin and run down the walls of the tube, alternating in position with the angles of the jelly mass (Figs. 1 and 2). One band corresponds in position with the deep external groove. (Fig. 4, Gl. 1.) In two of the specimens indications can be detected of a very finely attenuated plate-like structure running across to each of the four faces of the jelly from the modified bands. (Fig. 4., Spt.) One of these plates corresponds in position with the deep groove, but in three specimens of which sections were cut I could not distinguish the faintest trace of any structural differentiation representing them. There is not the slightest indication of any canal system other than the central tube. The relationship of the various structures referred to are represented diagramatically in Figure 4.

In some specimens the bands on the wall of the central cavity do not extend as far as the oral opening, but in others they do. Each has clearly a double structure, probably representing two rows of cells, and they (together with the small aboral canal and two special structures to be described later) stain much more deeply than any other part. In Figure 6 a small part of one is shown, together with the adjacent lining of the tube. The band shows no clearly marked outline of cells, only faint indications of this. The protoplasm is reticulated, and when stained stands out in strong contrast to the homogeneous jelly in contact with which it lies like a ribbon. The cells, if such they be, are much flattened out, and contain numerous rounded and irregularly shaped bodies, which stain deeply and sometimes enclose unstained spherical portions. Between the bands the remaining part of the wall of the tube is lined by a single layer of extremely thin cells (Fig. 6, Gl. 2) with nuclei that are smaller than the dark bodies in the bands, and take stain much less deeply. These cells are evidently easily displaced, as in some cases they are absent, and the wall of the tube is actually

formed of jelly. In transverse section they are like the thinnest of pavement cells,

The aboral canal, though small in diameter, is very clearly defined, and as already described, opens into the groove that furrows one side of the organism, and ends in the conical projections on the aboral surface (Fig. 2). The wall of the canal is formed of a definite gelatinous material which stains somewhat more deeply than the ordinary jelly mass, and contains nuclei.

Aboral Organ.—In two specimens there is a curious but definite bunch of projections associated with the aboral canal, lying in the groove close to its external opening. The bunch of processes is transversed by short canals which open into the aboral canal. (Figs. 7 and 8. Al. 2, Al. 3.) The body of the whole mass is made of the same gelatinous material as the main organism, with, however, a tendency to a fibrous formation. Nuclei are scattered irregularly through it, but in addition to these large numbers are arranged in definite relationship to the external surface, and the walls of the canals (Fig. 7), indicating a cellular formation, though no trace of cell outline can be distinguished. Most of the projections are club-shaped, and when stained and cut in section show the structure represented in Figure 8, Pr. There are a number of very definite dark bodies often arranged in two roughly concentric series. The processes are apparently only solid masses of jelly in which these block-like structures are embedded, and their arrangement and general resemblance to what are evidently nuclei in other parts of the processes and in the walls of the canals traversing the latter, suggest the idea that they also are nuclear. If this be so they are of large size in comparison with the cells with which they are associated. It is just possible that some of the canals open on the surface of this enigmatic organ. In three parts there are distinct indications of such openings, but I have not been able to determine the point with certainty.

The Oral Organ.—The only structure remaining to be described is one that is present in four out of the fourteen specimens; no trace of it is to be found in any of the others. In two of the four it is well marked. In Figure 3 a small process can be seen projecting from the oral opening. It is attached to the oral end of one of the cellular bands on the wall of the

central cavity. In the specimen drawn in Figure 3, the process is horse-shoe shaped, which is probably its normal form. It is very small—its relative size can be judged from the figure referred to, which is five times the size of the original. The one represented in Figure 9 is a part of the structure in another specimen that was stained and cut by the freezing microtome. In this the close part of the horse-shoe extended round one quarter of the oral opening, that is, each of the two limbs corresponded in position to one of the cellular bands on the wall of the central cavity. Unfortunately, the section was somewhat broken, and I am unable, amongst the broken parts, to determine definitely the nature of one of the limbs, which appears to be somewhat smaller than the one figured, which has retained its original position. In one of the four specimens in which this organ can be seen, the part attached to the oral surface is alone present, the two limbs of the horse-shoe either not having been developed, or, more likely still, they have been knocked off by the buffeting of the waves on the shore.

The general structure is seen in Figure 9, which represents, as the section was a thick one, a drawing of the solid object. The part attached to the oral surface has the appearance of a semifibrous gelatinous band containing many nuclei, often arranged in rows (d). It is apparently attached along its whole length, but in parts there are remarkable lines of nuclei (e) associated with structures that look like special attachments to the jelly around the mouth. When examining this section under the dissecting miscroscope, I separated the greater part of the horseshoe lying between the two limbs from the oral margin with comparative ease, but at each of the points from which the limbs depend the attachment is a very firm one. It will be noticed that the nuclei, if such they be, of the bands with which this horseshoe-shaped organ is connected are much larger than those of the latter.

The limb shows three different parts, first a fibrous part (a), second a gelatinous part with regularly arranged nuclei (b), and third, a well-marked row of densely packed nuclei (c), lying along a well-marked track between the first and second. At the spot marked N, the limb has a decidedly narrow neck where it is attached to the edge of the oral opening (o.m.). In this region

there are rounded lumps of gelatinous material containing irregularly arranged nuclei. A more or less definite line of nuclei (d) appears to run along the closed end of the horseshoe, and then on to the limb. The general appearance gives the impression that a proliferation of cells is taking place in the attached portion, and in the neck region just alluded to, and that the cells thus formed are wandering on to the limb.. If this be the case, it is possible that the organ is of the nature of a stolon.

General Remarks.—It appears to be impossible to indicate the relationships of this curious organism. The marginal bands at first call to mind those of a ctenophoran, and the main central and aboral canals in like manner suggest the stomodaeal and infundibular canals respectively, but there is no trace whatever of any structures resembling the canals that arise from the infundibulum: there is no sense organ: no nerve system: no contractile tissue; the marginal bands are entirely deviod of cilia, and if the deep groove has any relation to a tentacle sheath it is remarkable for its asymmetrical development. The total absence of cells on the external surface is an extraordinary feature, nor do the specimens convey the idea of this being due to accident or bad state of preservation, as they are all in precisely the same condition, and, moreover, the cells of the bands on the canal wall and of the oral and aboral organs are all intact.

Comparison with the members of any other group of animals appears impossible, and the only hypothesis as to its significance that I can offer is one that is suggested by the oral organ. In connection with this I have described above what has the appearance of a proliferation of cells taking place on and close to the part which is attached to the oral margin. From this part, also, it looks very much as if the cells were passing off on to the limb of the organ. If this be so, then it is possible that the latter is an early stage in the development of a stolon, and that this enigmatical organism is a nurse form in the life history of some animal—but as to what this animal may be we have at present not the slightest clue.

EXPLANATION OF PLATES XXIV., XXV.

Fig. 1.—General view from the side. The lateral groove is represented between the marginal bands 1 and 2. Marginal band 4 is seen through the transparent jelly.

Fig. 2.—A portion of the aboral surface on a larger scale, to show the conical elevation cut through by the groove, the upper part of the main central canal with its four bands of cells, the small aboral canal and the processes forming the aboral organ close to the opening of the canal into the groove.

Fig. 3.—Oral view. The mouth is seen in the centre leading directly into the central canal. The numbers 1, 2, 3, 4, correspond in position to the marginal bands seen from the side in Figure 1. The downward growth, conical in form, of the angle associated with marginal band 1, produces the appearance of asymmetry which is probably also accentuated by irregular contraction during preservation.

Fig. 4.—Diagrammatic transverse section across the middle of the body. The marginal bands are numbered, as in the other figures. The relative positions of the marginal bands, lateral groove, ribbons of cells on the walls of the central cavity, and the faintly marked septa (?) are shown. The latter are indistinguishable in sections, and only visible in a few specimens.

Fig. 5.—Downward conical process of one angle of the oral, and the oral end of one lip of the lateral groove drawn on a larger scale to show the serrations.

Fig. 5a.—Portion of a marginal band to show the "cuticle" and punctated material beneath. (Zeiss F. Oc. 2.)

Fig. 6.—Part of one of the four ribbon-like bands of cells on the wall of the central cavity, together with the surrounding cells lining the rest of the cavity. All are extremely thin, the latter having much more definite outline than the former. (Zeiss F. Oc. 2.)

Figs. 7 and 8.—Sections across the aboral organ, showing the canals that traverse it, and the regular arrangement of the nuclei in the jelly of which it is formed.

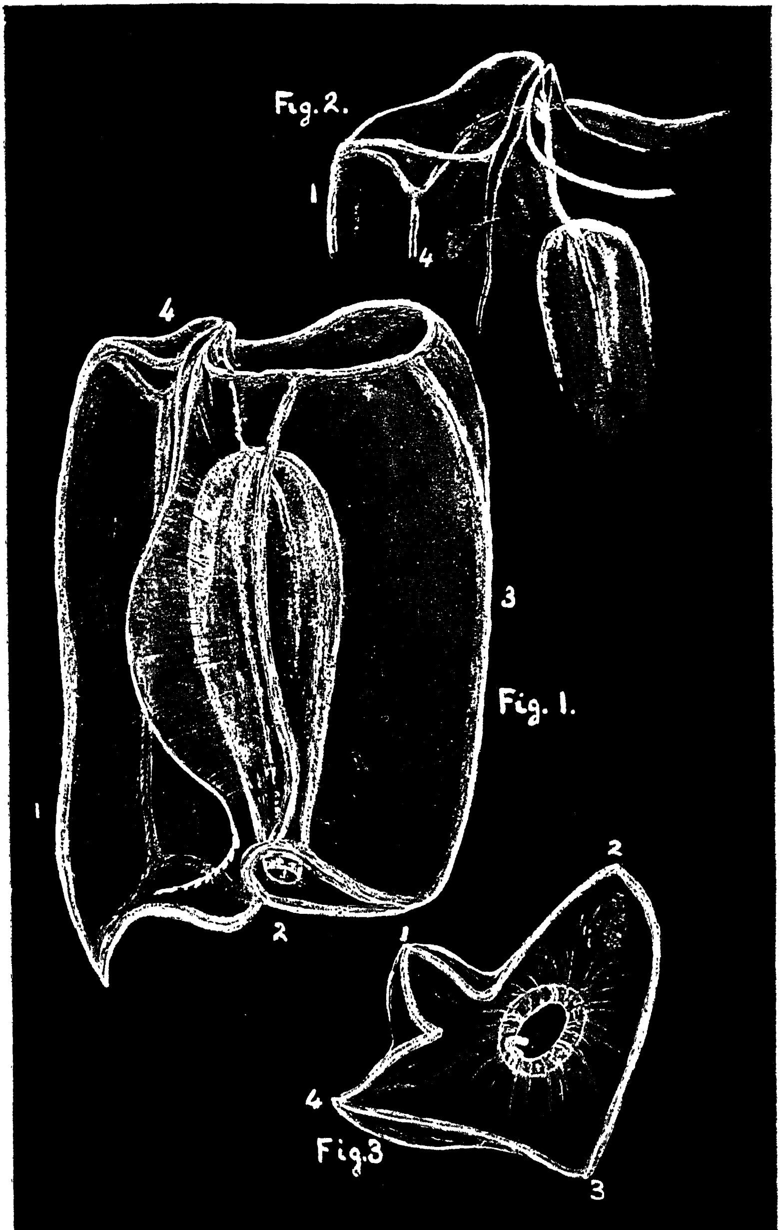
Fig. 2.
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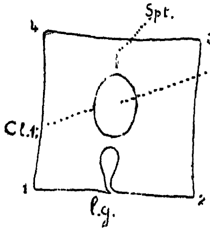


Fig. 4

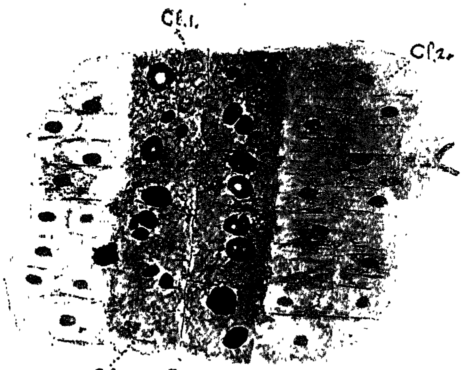


Fig. 6.

Fig. 5a.

Fig. 5.

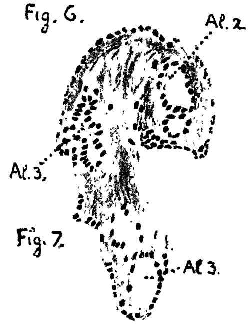


Fig. 7.

Fig 8.

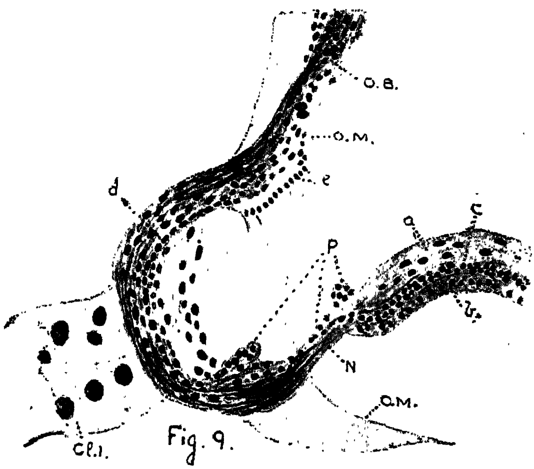


Fig. 9.

Fig. 9.—A portion of the oral margin with a part of one limb of the "oral organ."

LIST OF REFERENCE LETTERS, ETC.

a, b, c, d.	Special rows of cells associated with the "oral organ."
Al. 1	Main central canal.
Al. 2	Aboral canal.
Al. 3	Canals traversing the "aboral organ."
B.l.g.	Lip of lateral grove.
Ct.	"Cuticle" of marginal band.
E.	Nuclei of special cells for attachment of "aboral organ.
Gl. 1	Ribbon-like band of cells on walls of central cavity.
Gl. 2	Flattened cells on walls of central cavity.
L.g.	Lateral grove.
N.	"Neck" of "oral organ."
O.B.	Part of "oral organ" attached to oral margin."
O.M.	Margin of oral opening.
P.	Proliferating cells.
Pr.	Solid processes of "aboral organ."
Pct.	Punctated material of marginal band.
Spt.	Faintly marked septum (?).

Art. XVI.—*Polyzoa from the Gilbert Islands.*

By C. M. MAPLESTONE.

(With Plates XXVI.-XXVIII.).

[Read 10th September, 1908].

Some five years ago the Rev. Dr. Porter, of Petersham, N.S.W., sent me some slides of Polyzoa that he had received from the Gilbert Islands. At that time I was not able to do more than make a cursory examination of them, and I laid them aside. Now, however, I have been able to make a thorough examination of them, and, as would naturally be supposed from the locality from which they came, being situate on the Equator, in longitude 174 deg. East, I found that almost all of them were new to science. Many of the specimens are not in very good condition, having minute fragments of sand, etc., adhering to them, and some of them are in a fragmentary state; still among them I have found many of considerable interest.

In addition to those described below, there were a specimen of a *Farciminaria* too much shrivelled up to identify; a specimen of a very slender form of *Tubucellaria cereoides* less than one-fourth the diameter of those found upon this coast, but otherwise identical with them; a *Retepora* indistinguishable in its zooecial characteristics from *R. producta*, Busk., recorded in the "Challenger" Polyzoa as from Tongatabo and the Philippine Islands (Gilbert Islands are about midway between these places), but the branches are free, not anastomosing, and very much narrower and more delicate than those described by Busk; and a specimen of *Schizoporella cecilii*, which, though not exactly the same as the form found here, cannot be differentiated from it; also specimens of *Reteporae*, *Crisiae*, *Lichenoporae*, *Tubuliporae*, and other genera which cannot be definitely placed, being more or less imperfect, and on the slide containing the *Catenaria* are some pieces of a *Notamia*, but as the dorsal surface only is visible, the species cannot be determined.

Catenaria infundibuliformis, n. sp. (Pl. XXVI., Fig. 1).

Zoarium free. Zooecia tubular below, expanded and ventricose above; surface punctate with a smooth longitudinal band on the dorsal surface; distal end smooth, surmounted by 4 to 6 spines and two umbonate projections. Thyrostome orbicular; operculum opening upwards.

The specimens are entangled in a mass of sponge threads and are composed of single disconnected zooecia, so that the mode of branching does not appear; "a" and "b" are side views of two different specimens; "c" and "d," front views of two others; "d" showing the operculum.

Scrupocellaria gilbertensis, n. sp. (Plate XXVI., Fig. 2).

Zooecia 6 to 10 in an internode, elongated. Thyrosrome arched above, straight below; surrounded by an elevated elliptical area, in the lower portion of which is a slightly raised crescentic punctate area. Scutum suborbicular with rounded boss. Three to five spines above the thyrostome. Lateral avicularia large, pointing outwards and upwards, with a ligulate mandible.

On the front of the zooecia, below the elevated area there is a small umbonate process, probably avicularian, but the specimen is small, somewhat imperfect and much covered with small grains of sand, etc., so that it is difficult to make out the details, but sufficient are visible to show it is a good species.

Megapora gilbertensis, n. sp. (Plate XXVI., Fig. 3).

Zoarium encrusting. Zooecia oval, with raised margins. Thyrostome arched above, straight below, with a chitinous rib separating it from the proximal membranous flap; a crenulated ridge extending from each side of the thyrostome in a curve to the margins, thence downwards to the base enclosing a granulated, slightly depressed area in which are two large subcircular perforations (opesia), in some cases covered with an epitheca.

This specimen is growing upon a small red coral; it much resembles in appearance Micopora coriacea, owing to the presence of the two large perforations in the front wall, but the peculiar thyrostome with a raised ridge separating the upper

and lower parts of the operculum show it to be a Megapora; the membranous covering of the lower part is sometimes wanting, and shows an opening into the interior of the zooecia.

It is worthy of note that the other two species of this genus have been found in high latitudes only; M. ringens. Busk. in the Shetland Islands (this species has no perforations in the front wall); M. hyalina, Waters, is recorded from the Antarctic region among the Polyzoa obtained on the voyage of the "Belgica." This species has small perforations in the front wall, and also some spines. The present specimen has no spines.

Steganoporella porteri, n. sp. (Pl. XXVI., Fig. 4).

Zoarium encrusting. Zooecia quadrate, margins raised. Cryptocyst occupying about two-thirds of area; distal margin curved and studded with small tuberosities; surface perforated, the perforations have raised margins; "tube" opening upwards.

Locality, Solomon Islands.

I include this species from the Solomon Islands, as it differs very considerably from the next species described, and from those described by Prof. Harmer in his revision of the genus published in the Quarterly Journal of Microscopical Science, vol. 43, p.. 225, ff. The specimen is somewhat imperfect, and has minute fragments of sand, etc., adhering to it which obscure the surface of some of the zooecia. Only a few show any part of the membranous outer wall, and one or two of the opercula are present. There is no trace of dimorphism in the zooecia. The "tube" takes the form of a cup, being constricted into a narrow neck at a short distance below the upper surface. The perforations in the cryptocyst are very peculiar, having raised margins, causing an appearance similar to that of a thin metal plate pierced with a blunt punch from beneath.

Steganoporella minuta, n. sp. (Pl. XXVI., Fig. 5).

Zoarium encrusting. Zooecia subhexagonal, arched above; margins raised, very rugose. Cryptocyst granulated, not perforated; opening subtriangular, but very irregular in shape.

I have placed this in Steganoporella, as the zooecia have a

similar structure to that of the other species of the genus. The proximal margin of the opening in the cryptocyst is very irregular in form, but in every case the protruding portion shows an incurved part in the middle, which I consider represents an imperfectly developed "tube." The zooecia are very much smaller than those of any other species, and the surface of the cryptocyst is granulated, not perforated. There is no trace of the membranous front wall in the specimen.

Cribrilina gilbertensis, n. sp. (Pl. XXVI., Fig. 6).

Zoarium encrusting. Zooecia oval, ventricose, with 8 to 12 transverse rows of minute globular elevations. Thyrostome arched above, straight below, surrounded with a raised margin bearing seven long spines. On each side of the thyrostome there is a very long acute avicularium placed slightly above it, extending and opening directly upwards.

This species resembles C. radiata, but has not the central pore below the thyrostome of that species, and it has very long avicularia. It is a very delicate form, and has a glassy-like appearance. In the specimen from which the figure is drawn only the bases of the spines round the thryrostome are present, but in another specimen, which otherwise is somewhat imperfect, they are shown as delicate spines almost as long as the avicularia.

Lepralia trispinosa, n. sp. (Pl. XXVI., Fig. 7).

Zoarium encrusting. Zooecia oval or pyriform, ventricose; surface slightly granulated. Thyrostome arched above, straight below, with three long spines above. An acute avicularium with a slightly curved mandible on the proximal margin of the thyrostome.

A small, delicate species. The three long spines and the oral avicularium distinguish this species from others.

Hiantopora corniculata, n. sp. (Plate XXVI., Fig. 8).

Zoarium encrusting. Zooecia totally immersed and undefined; surface rugose, with irregularly shaped perforations. Long ligulate avicularia scattered about, and also some small,

very acute ones. Thyrostome orbicular, margins slightly raised; a long truncated, upright process on one side.

The long upright truncated processes are not only on the edge of the thyrostomes, but occasionally are present on other portions of the surface of the zoarium. Fig. 8a gives a side view, and Fig. 8b is drawn looking down straight upon the specimen, and shows the flat tops of the processes, one of which is on the surface of the zoarium, at a distance from the thyrostomes. In many of the zooecia the perforations are much more numerous than in those figured, making the surface cribriform.

Hiantopora corrugata, n. sp. (Pl. XXVII., Fig. 9).

Zoarium encrusting. Zooecia oval, ventricose, immersed; surface with irregularly shaped hollows and pores, sometimes radiating from the thyrostome. Thyrostome arched above, curved below, with a raised margin.

The surface very irregularly cribriform, in many instances it consists of raised narrow ribs with deep hollows and pores between. The proximal lip of the thyrostome is often elevated into an umbo.

Microporella irregularis, n. sp. (Pl. XXVII., Fig. 10).

Zoarium encrusting. Zooecia quadrate, but very irregular in shape; surface very minutely mamillated, sometimes quite smooth. Thyrostome arched above, straight below; a reniform covered opening below it. Ooecium globular, smooth, with semicircular opening and operculum.

This is near *M. malusii*, but differs from it in the smooth ooecium and mamilliform surface. One of the zooecia has a row of minute mamillae near the distal end. The specimen is a very small one upon which to found a new species, but I thought it worthy of a place in this paper on account of the peculiar abnormality shown; the ooecium on the left side of the specimen (as figured) I consider to be the normal form; the other, which is apparently common to two zooecia, is mis-shapen, has no operculum, and the zooecia adjacent to it do not appear to have any thyrostomes.

Microporella falcifera, n. sp. (Pl. XXVII., Fig. 11).

Zoarium encrusting. Zooecia immersed, oval, elongate, ventricose; surface rugose, with small pores and rounded depressions, sometimes in linear series round the margins. A minute pore with a raised border in the centre of the zooecium. Thyrostome arched above, straight below, with slightly raised margins; an acute avicularium below proximal border, and one, or more, on the surface of the zooecium, some of them very small, with very acute mandibles. Large vicarious avicularia with long curved mandibles and a large pore, always situated on the incurved side of the mandible, scattered about the zoarium.

The chief peculiarity of this species is the very large vicarious avicularium, with a long, acute, curved mandible and the presence of a large round pore in the surface of the cell.

Schizoporella ensifera, n. sp. (Pl. XXVII., Fig. 12).

Zoarium encrusting. Zooecia irregularly orbicular or oval; surface uneven and crystalline in appearance. Thyrostome rounded, with a shallow sinus in proximal margin; three spines on distal border; two slightly curved ridges below, enclosing a slightly depressed subtriangular area. In some of the zooecia one of these ridges is replaced by a long falciform avicularium. Ooecium orbicular, contracted proximally; distal portion punctate.

A very small, delicate, glassy-looking species. The zooecia are very irregularly grouped.

Schizoporella perlata, n. sp. (Pl. XXVII., Fig. 13).

Zoarium encrusting, robust. Zooecia elongated, oval; surface smooth, with small annular dark markings. Thyrostome orbicular with raised margins; a very shallow sinus proximally; a small avicularium with a triangular mandible just below or to one side.

A very distinct species; on one of the zooecia figured there is an apparently imperfect avicularium just below the middle. The surface is covered with small, annular, dark markings, with

a lighter-coloured centre, evidently being the epitheca covering pores in the calcified wall of the zooecia.

Schizoporella nitida, n. sp. (Pl. XXVII., Fig. 14).

Zoarium encrusting. Zooecia oval, ventricose; surface smooth, with slightly elevated ridges radiating towards the centre. Thyrostome with raised margin, arched above, straight below, with a deep, narrow sinus in the lower lip; a very small avicularium close to the margin on one side. A few large vicarious avicularia, with spatulate mandibles scattered about the zoarium.

A neat, small-celled form. The vicarious avicularia are characteristic of this species.

Schizoporella granulata, n. sp. (Pl. XXVII., Fig. 15).

Zoarium encrusting. Zooecia irregularly quadrate or oval; surface granulated or pitted; a raised line between the zooecia. Thyrostome with raised margins, orbicular, with a deep sinus in the lower lip. A small subtriangular avicularium below the thyrostome near the middle of the zooecia, pointing either vertically or transversely.

This is near S. triangular, Hincks and S. pachnoides, McG., but I think distinct: the avicularium is very much smaller, and is sometimes placed transversely.

Schizoporella porifera, n. sp. (Pl. XXVII., Fig. 16).

Zoarium encrusting. Zooecia ovoid, ventricose; surface covered with minute circular pores. Thyrostome subtriangular, with raised margins, arched above, with a deep sinus in the proximal margin. An acute avicularium on one side close to the margin of the thyrostome in most of the zooecia, varying, however, in size, and also in direction.

Schizoporella perarmata, n. sp. (Pl. XXVII., Fig. 17).

Zoarium encrusting. Zooecia elongate, quadrate; surface much depressed, perforated with small round pores; margins

very high, rugose, with small oval avicularia scattered about upon them. Thyrostome orbicular, with raised margins; a wide, deep sinus on the proximal margin.

This is a very peculiar form. The zooecia are bounded by high, rugose, marginal edges, on which are scattered a great number of small oval avicularia, giving it a very unique appearance; similar avicularia are present on the surface of most of the zooecia in the distal part on each side of the thyrostome.

Pollaploecium, n. gen.

Zoarium free, dichotomously branched; branches consisting of internodes, joined by corneous tubes. Internodes composed of six to ten zooecia, united on their dorsal surfaces, facing all ways. Thyrostome with a sinus on proximal lip.

This genus is near *Diploecium*, Kirkpatrick (recorded from Mauritius), but differs therefrom chiefly by the internodes being composed of six to ten zooecia, whereas in *D. simplex* (the only species) there are only two in an internode placed back to back; the ooecia also are different.

Pollaploecium gilbertensis, n. sp. (Pl. XXVIII., Fig. 18).

Zooecia oval or pyriform, ventricose; surface minutely punctate; bordered by narrow, raised lines. Thyrostome arched above, straight below, with a deep sinus in the middle. Ooecia globose.

This is the most interesting species in the collection. As noted above, this is near *D. simplex*, and I would have placed it in the same genus, but the number of zooecia in an internode is made a generic distinction by Kirkpatrick. The ooecia are placed above the zooecia, and are continuous with them, only a slight suture showing the line of demarcation between them.

Mucronella umbonata, n. sp. (Pl. XXVIII., Fig. 19).

Zoarium encrusting. Zooecia immersed, area undefined; surface with stellate and irregularly-shaped pores. Thyrostome orbicular. Peristome much elevated, with a straight, narrow, deep notch in the side; one side of which is more or less raised

into a prominent umbo. Ooecium oval, raised above the surface of the zoarium, with a triangular opening on the summit.

The form of the peristome in this species is very various, but the narrow, slit-like notch is always present, though not always in the same position, and the raised umbo is in most cases very much more prominent than shown in the figure, but, as in them, the thyrostome is consequently almost hidden, so the figure was drawn from that portion of the zoarium bearing the only ooecium present on the specimen.

Mucronella rugata, n. sp. (Pl. XXVIII., Fig. 20).

Zoarium encrusting. Zooecia elongated; surface very rugose, covered with irregular, rough elevations. Thyrostome orbicular, with a prominent quadrate mucro in the proximal margin. Occasionally a very large avicularium, with a long, acute mandible, on one side of the zooecia, pointing horizontally. Marginal zooecia furnished with five slender spines on the edge of the thyrostome. Ooecium orbicular, somewhat flattened, with a round umbo in the centre and others round the margin and on the sufrace.

A very rugose species. With age the spines seen on the marginal zooecia disappear.

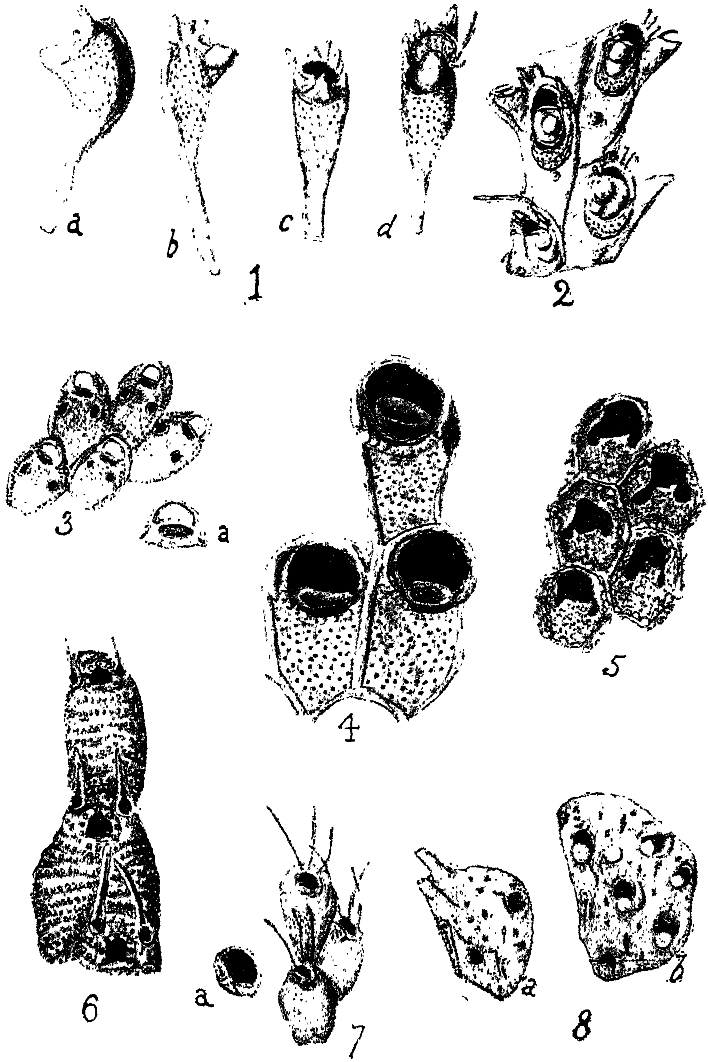
Cellepora crenulata, n. sp. (Pl. XXVIII., Fig. 21).

Zoarium encrusting. Zooecia orbicular or cylindrical, closely crowded together so that only the upper or distal surface is visible. This surface is covered with irregularly shaped mamillations, mostly radially arranged. Thyrostome orbicular, margin slightly raised and crenate. A few large wedge-shaped avicularia scattered about the zoarium.

The mandible of the avicularium is wedge-shaped and longitudinally ribbed, a very uncommon shape.

EXPLANATION OF PLATES XXVI.-XXVIII.

Fig. 1.—Catenaria infundibuliformis. × 36.
„ 2.—Scrupocellaria gilbertensis. × 50.
„ 3.—Megapora gilbertensis. × 25. 3a × 36.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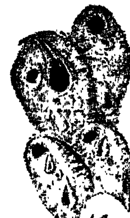

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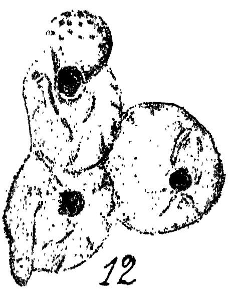

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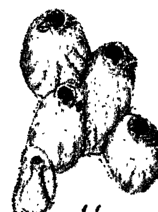

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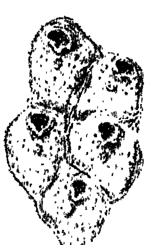

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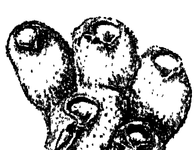

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Fig. 4.—Steganoporella porteri. × 25.
„ 5.— „ minuta. × 25.
„ 6.—Cribrilina gilbertensis. × 50.
„ 7.—Lepralia trispinosa. × 25. 7a × 50.
„ 8.—Hiantopora corniculata. × 25.
„ 9.— „ corrugata. × 25.
„ 10.—Microporella irregularis. × 25.
„ 11.— „ falcifera. × 25.
„ 12.—Schizoporella ensifera. × 36.
„ 13.— „ perlata. × 25.
„ 14.— „ nitida. × 25.
„ 15.— „ granulata. × 25.
„ 16.— „ perifera. × 25.
„ 17.— „ perarmata. × 25.
„ 18.—Pollaploecium gilbertensis. × 12. 18a × 36.
„ 19.—Mucronella umbonata. × 25.
„ 20.— „ rugata. × 25.
„ 21.—Cellepora crenulata. × 25.

APPENDIX.

Change of name of new species of Polyzoa (Idmonea fasciculata).

The name "*angustata*" given to a species of *Idmonea* described by me in Part X. of "Further descriptions of the Tertiary Polyzoa of Victoria," on page 234, vol. xxi. (new series), pt. i., is, I find, preoccupied; I therefore substitute for it the name "*fasciculata*."

Line 21, page 234, should read "*Idmonea fasciculata*, n.s. (Pl. VII., Fig. 6)."

C. M. MAPLESTONE.

29/12/08.

Art XVII.—*Description of a New Species of Peripatoides from West Australia.*

By BALDWIN SPENCER, M.A., C.M.G., F.R.S.,

Professor of Biology in the University of Melbourne.

[Read 10th September. 1908.]

In March, 1907, Mr. H. M. Giles found in West Australia two specimens of a species of Peripatoides distinct from *P. leuckarti var. occidentalis*, the only one hitherto known from that part of the continent. It is evidently of rare occurrence, as Mr. Giles, though constantly on the lookout, has only recently succeeded in securing more specimens. In this instance he found three adults and four young ones, but, unfortunately, though two adults reached Melbourne safely, one adult and the young ones completely perished. The four adult individuals serve, however, to establish the existence of this second species in West Australia, and I have much pleasure in associating with it the name of its finder, who has devoted much time to the search. It may be described as follows:—

Peripatoides gilesii, sp. n.

Size of Body.—Three female specimens measure respectively 22 mm., 25 mm. and 27 mm. One male measures 25 mm.

Colour.—The general body colour is dull greenish, yellow or reddish brown. There is no set pattern, but each specimen has a narrow, darker band down the mid dorsal line, with a median very thin light line—so thin as only to be visible with the aid of a lens. It is not nearly so well marked as in the specimen of *P. leuckartii*, figured by Bouvier,[1] and closely resembles that in *Ooperipatus insignis*. On each side of the body there is a broad, lighter band just above the level of the legs. The whole

1 Ann. des Sci. Nat., 9th series, tome ii., 1905. This is called *P. orientalis*, by Bouvier, pl. xi. The nearest approach amongst all those figured by Bouvier to the skin of *P. gilesii* is that of *P. eiseni*, pl. 4, fig. 31.

under surface of the body and of the feet is devoid of pigment save for insignificant speckles scarcely visible without a lens.

The whole surface is thrown into a number of transverse ridges, ornamented, as usual, by papillæ, of which two varieties are present—(1) a smaller, and (2) a larger. The former is usually black, the latter has a terminal black part (the equivalent in size of the whole of the smaller kind), with a lighter basal part surrounded by a light yellowish patch of skin. Each of the larger papillæ terminates in a minute colourless spine which is apparently wanting on the smaller ones.

The general colour of the body is affected, to a large extent, by that of the papillæ. In the greenish coloured specimens they are always black, but in the brownish ones the great majority of them are chestnut-brown in colour. In all cases the rings are continuous across the mid dorsal surface, though they are crossed one after the other by the thin median light line, which, however, in no way affects the continuity of the ridge, and may occasionally be quite wanting, a dark papilla then occupying the very middle line. The papillæ throughout are arranged in a single line on each ridge. There appear to be always seven ridges running between each successive pair of legs.

Ambulatory Appendages.—The claw-bearing legs are sixteen in number,[1] the first and last being somewhat smaller than the others. Each has three spinous pads and about eight or nine rings of papillæ, which contain only a very minute amount of pigment on the ventral side of the leg. On the proximal side of the first of the rings, that is, just where the leg joins the body, there is a small but very distinct round opening bordered by a circle of papillæ containing more pigment than those elsewhere on the ventral surface. This indicates the position of the external opening of the nephridium, and can be seen on every leg except the first and last pairs, though most noticeable in the middle and hinder parts of the body. In front of segment five or six it becomes smaller and more slit-like.

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1 As an abnormality one specimen has fifteen legs on the left side and sixteen on the right. The pairs are quite regular as far back as the thirteenth. The sixteenth pair is normal on each side, but the one between this and the thirteenth on the left side is opposite the middle of the internal between the fourteenth and fifteenth legs of the right side.

Crural Glands.—In one of the four specimens each of the legs, 6-14, carries a definite, small white glandular patch placed on the distal side of the nephridial opening, and always separated from the latter by two rings of papillæ. These, presumably, indicate the openings of crural glands, but I can see no trace of them on the two last pairs of legs, nor in the region of the reproductive opening. Their presence indicates the fact that this one specimen is a male and the three others females. In the latter there is no trace of any ovipositor, and in both males and females the generative opening lies between the base of the last pair of legs.

Jaws.—The first jaw is simple in all the specimens, there being no trace of any accessory tooth. The second jaw has four clearly-marked and one minute accessory tooth.

The number of the legs, together with the structure of the jaws, serves to distinguish this species from all other Australasian species of either of the genera, Peripatoides or Ooperipatus.

Locality.—Armadale, near Perth, West Australia. Collected by Mr. H. M. Giles.

Art. XVIII.—*Obsidianites—Their Origin from a Chemical Standpoint.*

By H. S. SUMMERS, M.Sc.

(Government Science Research Scholar, Geological Laboratory, University of Melbourne).

[Read 8th October, 1908].

This paper is written in order to bring together the various analyses which have been made of obsidianites and allied substances, and an attempt is made to show what bearing the chemical composition has on the various hypotheses that have been advanced to account for the origin of these interesting objects. There is no necessity for any description of form, or mode of occurrence, of obsidianites, as this part of the subject has been exhaustively treated by Mr. Walcott,[1] who also gives numerous illustrations of the different types found.

Chemical Composition.

In searching through the literature on obsidianites, I have only succeeded in finding the records of seven complete analyses, and one of these, that of a Victorian specimen, published in the Melbourne Exhibition Catalogue, 1866, and quoted by Mr. Walcott, is much too inaccurate for purposes of classification, and is omitted from the following table of analyses. Mr. Walcott kindly supplied me with a broken obsidianite from near Mt. Elephant, Victoria, and this has been carefully analysed by Mr. G. Ampt, B.Sc., in the Chemical Laboratory of the University. Mr. Ampt has also analysed the material of three small buttons from near Hamilton, Victoria. These specimens were obtained for me by Professor Spencer, through Mr. C. French. A third analysis has been made by Mr. Ampt of a button from Lake Eyre District, South Australia. This button was one of

1 Proc. Roy. Soc. Victoria, vol. xi., n.s., pt. I., 1898.

a number presented by Mr. Kemp, of Peake Station, Lake Eyre District, to the members of Professor Gregory's party during their trip to that area. Besides making accurate determinations of the main constituents of the obsidianites, Mr. Ampt has made an exhaustive determination of the rarer constituents, and must be congratulated on the high standard of his analytical work.

Several writers have referred to the chemical composition of obsidianites. Mr. Walcott,[1] while pointing out that the analyses he quotes show that the glasses belong rather to the trachytic than to the rhyolitic series, adds:—"It is to be regretted that so little has been done in their chemical examination, because it is quite possible that each occurrence may present features in common, while differing from those of others. We should also be able to ascertain whether any divergence from ordinary obsidian can be established." Mr. Simpson,[2] after quoting an analysis, states:—"In chemical composition this specimen agrees with those found in Victoria, New South Wales, and Central South Australia, as well as from Billiton and other islands of the East Indies. It is identical with that of ordinary obsidian of undoubted volcanic origin." Referring[3] to the analyses of obsidianites from the Upper Weld and Pieman, Dr. Hillebrand says:—"The analyses revealed compositions which, while not absolutely unique in petrographic literature, are seemingly approached but once or twice. Very unusual is the molecular preponderance of potash over soda in a rock of this character so high in lime."

In dealing with glasses such as the obsidianites, the microscope gives us no help in determining the composition, so that we must depend entirely on chemical analyses. It should, however, be noted that, having obtained a good series of analyses, the careful determination of the specific gravity of a specimen should give an approximate idea of its composition. It is impossible to properly compare analyses, simply stated as percentages of oxides, and the use of some such scheme of classification as that worked out by Messrs. Cross, Iddings,

1 Proc. Roy. Soc. Victoria, vol. xi., n.s., pt. I., 1898, p. 31.
2 Bull. No. 6. West Aust. Geol. Survey, p. 79.
3 Annual Rep. of the Sec. for Mines, Tasmania, 1905, p. 21.

Pirsson and Washington[1] is absolutely necessary in order to find the true relationship between glasses, such as the obsidianites.

The analyses of the obsidianites are as follows :—

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
SiO_2 -	72.39	76.25	77.72	71.22	70.62	71.65	64.68	69.80	73.59
Al_2O_3 -	13.12	11.30	9.97	13.52	13.48	11.96	16.80	15.02	12.35
Fe_2O_3 -	.42	.35	.32	.77	.85	6.62	6.57	.40	.38
FeO -	4.48	3.88	3.75	5.30	4.44	n. d.	1.01	4.65	3.79
MgO -	1.87	1.48	1.59	2.38	2.42	2.09	2.50	2.47	1.80
CaO -	3.17	2.60	2.40	3.52	3.09	3.03	3.88	3.20	3.76
Na_2O -	1.54	1.23	1.29	1.48	1.27	1.76	tr.	1.29	1.03
K_2O -	1.92	1.82	1.96	2.28	2.22	2.40	4.01	2.56	1.93
H_2O +	.11	.32	.15		.01			n.d.	.27
H_2O –	.02	.02	.04		.06			n.d.	.53
CO_2 -	nil	nil	nil		nil				
TiO_2 -	.76	.65	.86		.90			.80	.70
P_2O_5 -	nil	nil	nil		nil			nil	nil
MnO -	.05	.06	tr.	.28	.42	.16	.20	.18	.15
Li_2O -	st. tr.	st. tr.	st. tr.		st. tr.			st. tr.	
SrO -	nil	nil	nil					nil	f. tr.
BaO -	nil	nil	nil					?	f. tr.
Cl_2 -	nil	nil	nil		tr.				
SO_3 -	nil	nil	nil		tr.			?	nil
Cr_2O_3 -	?	nil	?						
NiO -	.06	.03	tr.		tr.			?	nil
CoO -	tr.		tr.		tr.				
ZrO_2 -								?	.01
Total -	99.91	99.99	100.05	100.75	99.75	99.67	99.65	100.37	100.29
Sp. Gr.	2.427	2.398	2.385	2.433	2.454	2.47	?	2.454	2.428

I.—Obsidianite from near Mt. Elephant, Victoria. Analysed by G. Ampt, 1908.

II.—Obsidianite from near Hamilton, Victoria. Analysed by G. Ampt, 1908.

III.—Obsidianite from Peake Station, near Lake Eyre, South Australia. Analysed by G. Ampt, 1908.

IV.—Obsidianite from between Everard Range and Fraser Range, South Australia. Analysed by C. v. John, 1900. Jahrb. d.k.k. geol. Reichsanst, Vienna, 1900, Vol. L, p. 238.

1 Journal of Geology, vol. x., pt. II., 1902.

V.—Obsidianite from near Coolgardie, Western Australia. Analysed by A. Hall, 1907.—Records of the Geol. Survey of Victoria, Vol. II., Part 4, 1908, p. 205.

VI.—Obsidianite from near Kalgoorlie, Western Australia. Analysed by E. S. Simpson, 1902.—West Aust. Geol. Survey. Bulletin No. 6, 1902, p. 79.

VII.—Obsidianite from near Uralla, New South Wales. Analysed by J. C. H. Mingaye, 1897. Proc. Roy. Soc. of Victoria, Vol. XI., N.S., Part I., p. 30.

VIII.—Obsidianite from the Upper Weld, Tasmania. Analysed by W. F. Hillebrand, 1905.—Report of the Secretary for Mines, Tasmania, for 1905, p. 21.

IX.—Obsidianite from Pieman, Tasmania. Analysed by W. F. Hillebrand, 1905.—Report of the Secretary for Mines, Tasmania, for 1905, p. 21.

By dividing the percentages by the molecular weights of the oxides the molecular proportions of the principal constituents are obtained, as under:—

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
SiO_2 -	1.207	1.271	1.295	1.187	1.177	1.194	1.078	1.163	1.227
Al_2O_3 -	.129	.111	.098	.133	.132	.117	.165	.147	.121
Fe_2O_3 -	.003	.002	.002	.005	.005	.006	.041	.003	.002
FeO -	.062	.054	.052	.074	.062	(.071)	.014	.065	.053
MgO -	.047	.037	.040	.060	.061	.052	.062	.062	.045
CaO -	.057	.046	.043	.063	.055	.054	.069	.057	.067
Na_2O -	.025	.020	.021	.024	.021	.028		.021	.017
K_2O -	.020	.019	.021	.024	.024	.026	.043	.027	.021
TiO_2 -	.009	.008	.011		.011			.010	.009
MnO -	.001	.001		.004	.006	.002	.003	.003	.002

The classification of the analysis of the obsidianite from near Mount Elephant may be given as an example of the method used. The molecules in their right proportions are distributed among the "normative" minerals with the following result:—

	Molecular Proportions.	Orthoclase.	Albite.	Anorthite.	Ilmenite.	Magnetite.	Hypersthene.	Corundum.	Quartz.
SiO_2	1.207	120	150	114			98		725
Al_2O_3	.129	20	25	57				27	
Fe_2O_3	.003					3			
FeO	.062				9	3	50		
MgO	.047						47		
CaO	.057			57					
Na_2O	.025		25						
K_2O	.020	20							
TiO_2	.009				9				
MnO	.001						1		

Reducing the foregoing results to percentages, we obtain the "Norm." or "standard mineral composition."

Mineral.			Norm.
Quartz	=	.725 × 60	= 43.5
Orthoclase	=	.020 × 556	= 11.1
Albite	=	.025 × 524	= 13.1
Anorthite	=	.057 × 278	= 15.8
Corundum	=	.027 × 102	= 2.8
Hypersthene	=	$\left\{\begin{array}{l}.047 \times 100 \\ .051 \times 132\end{array}\right\}$	= 11.4
Ilmenite	=	.009 × 152	= 1.4
Magnetite	=	.003 × 232	= .7

The "salic" minerals, i.e., the quartz, felspar and corundum total 86.3, and the "femic" minerals, i.e., the ferro-magnesian minerals and iron oxides total 13.5. In the same way the norms of the other obsidianites may be calculated, the results being as follows:—

NORMS.

Minerals.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
Quartz	43.5	51.8	52.7	38.4	41.0	38.6	37.2	38.8	46.6
Orthoclase	11.1	10.6	11.7	13.3	13.4	14.5	23.9	15.0	11.8
Albite	13.1	10.5	11.0	12.6	11.0	14.7		11.0	8.9
Anorthite	15.8	12.8	12.0	17.5	15.3	15.0	19.2	15.9	18.6
Corundum	2.8	2.7	1.3	2.3	3.3	.9	5.4	4.3	1.6
Hypersthene	11.4	9.5	9.1	15.6	13.0	14.0	6.2	13.4	10.3
Magnetite	.7	.5	.4	1.2	1.1	1.4	3.9	.7	.4
Ilmenite	1.4	1.2	1.7		1.7			1.5	1.4
Hematite							3.8		

Having calculated the norm., the next step is to classify each analysis. The classification of the analysis of the Mt. Elephant example is obtained in the following manner:—

$$\frac{\text{Sal.}}{\text{Fem.}} = \frac{86.3}{13.5} < \frac{7}{1} > \frac{5}{3} \quad = \text{Class II. Dosalane}$$

$$\frac{\text{Quartz}}{\text{Felspar}} = \frac{43.5}{40.0} < \frac{5}{3} > \frac{3}{5} \quad = \text{Order III. Quarfelic—Hispanare}$$

$$\frac{K_2O + Na_2O}{CaO} = \frac{45}{57} < \frac{5}{3} > \frac{3}{5} = \text{Rang. III. Alkali-calcic—Almerase}$$

$$\frac{K_2O}{Na_2O} = \frac{20}{25} < \frac{5}{3} > \frac{3}{5} \quad = \text{Sub-rang. III. Sodi-potassic—Almerose}$$

In a similar manner the classification of the other analyses is worked out, and a table is given showing the subdivisions to which each belongs.

No.	Class.	Order.	Rang.	Sub-rang.
I.	II. Dorsalane	III. Quarfelic Hispanare	III. Alkali-calcic Almerase	III. Sodi-potassic Almerose
II.	I. Persalane	III. Quarfelic Columbare	III. Alkali-calcic Riesenase	III. Sodi-potassic Riesenose
III.	I. Persalane	III. Quarfelic Columbare	III. Alkali-calcic Riesenase	III. Sodi-potassic Riesenose
IV.	II. Dorsalane	III. Quarfelic Hispanare	III. Alkali-calcic Almerase	III. Sodi-potassic Almerose
V.	II. Dorsalane	III. Quarfelic Hispanare	III. Alkali-calcic Almerase	III. Sodi-potassic Almerose
VI.	II. Dorsalane	III. Quarfelic Hispanare	III. Alkali-calcic Almerase	III. Sodi-potassic Almerose
VII.	II. Dorsalane	III. Quarfelic Hispanare	III. Alkali-calcic Almerase	I. Perpotassic (Urallaose)
VIII.	II. Dorsalane	III. Quarfelic Hispanare	III. Alkali-calcic Almerose	III. Sodi-potassic Almerose
IX.	I. Persalane	III. Quarfelic Columbare	III. Alkali-calcic (Piemanase)	III. Sodi-potassic (Piemanose)

To those unacquainted with this system of classification the subdivisional names can convey no meaning unless the positions of these subdivisions are known, and therefore I include a table of portions of Classes I. and II. The small numbers in brackets indicate the number of high-class analyses of terrestrial igneous

rocks, published by Washington,[1] in each subdivision. Some of the analyses fall into subdivisions, to which no name has been given by the authors of the system, and when this is the case, I have suggested names, chiefly for convenience in reference, and these names have been placed in brackets. In the complete classification there are five classes in all, and Classes I. and II. each have nine orders. All the rangs and sub-rangs into which Orders II., III. and IV. of Classes I. and II. are subdivided, are shown in the tables:—

CLASS I.—PERSALANE.

ORDER	II. BELGARE (13)	III. COLUMBARE (125)	IV. BRITANNARE (378)
RANG.		I. ALASKASE - (47)	I. LIPARASE - (110)
Sub-rang.		i. *x* (1)	i. Lebachose - (3)
Sub-rang.		ii. Magdeburgose (9)	ii. Omeose - (9)
Sub-rang.		iii. Alaskose - (31)	iii. Liparose - (78)
Sub-rang.		iv. *x* (3)	iv. Kallerudose - (12)
Sub-rang.		v. Westphalose (3)	v. Noyangose - (8)
RANG.	I. DARGASE - - (6)	II. ALSBACHASE - (51)	II. TOSCANASE (191)
Sub-rang.	i. (*Radomilitzose*) (2)	i. - - - - -	i. - - - - -
Sub-rang.		ii. Mihalose - (6)	ii. Dellenose - (6)
Sub-rang.	ii. *x* (2)	iii. Tehamose - (25)	iii. Toscanose (109)
Sub-rang.	iii. *x* (2)	iv. Alsbachose (16)	iv. Lassenose - (73)
Sub-rang.		v. Yukonose - (4)	v. Mariposose - (3)
RANG.	II. (MOLDAVASE) (5)	III. RIESENASE (26)	III. COLORADASE - (75)
Sub-rang.	i. (*Moldavose*) (3)	i. - - - - -	i. - - - -
Sub-rang.		ii. *x* (7)	ii. *x* (0)
Sub-rang.	ii. *x* (1)	iii. *Riesenose* - (11)	iii. Amiatose - (17)
Sub-rang.	iii. *x* (1)	iv. *x* (5)	iv. Yellowstonose (56)
Sub-rang.		v. Vulcanose - (3)	v. Amadorose - (2)
RANG.	III. (BUDWEISASE) (1)	IV. (PIEMANASE) (1)	IV. *x* (2)
Sub-rang.	i. (*Budweisose*) (1)	i. *x* (0)	i. - - - - -
Sub-rang.	ii. - - - - -	ii. (*Piemanose*) (1)	ii. - - - - -
Sub-rang.	iii. - - - - -	iii. - - - - -	iii. *x* (2)
RANG.		V. - - - - -	V. - - - - -

NOTE.—An *x* indicates that analyses are known which belong to this division, but that no name is suggested by the authors.

[1] United States Geol. Survey, Professional Paper, No. 14.

Class II.—Dosalane.

Order	II.	(0)	III. Hispanare	(15)	IV. Austrare	(241)
Rang.			I. Varingose	(5)	I. Pantellarase	(10)
Sub-rang.			i.	-	i.	-
Sub-rang.			ii.	-	ii.	-
Sub-rang.			iii. Varingose	(4)	iii. Grorudose	(6)
Sub-rang.			iv. *x*	(1)	iv. Pantellerose	(4)
Sub-rang.			v.	-	v.	-
Rang.	I.	-	II.	(4)	II. Dacase	(40)
Sub-rang.	i.	-	i.	-	i.	-
Sub-rang.			ii. *x*	(1)	ii. *x*	(2)
Sub-rang.	ii.	-	iii. *x*	(2)	iii. Adamellose	(19)
Sub-rang.	iii.	-	iv. *x*	(1)	iv. Dacose	(19)
Sub-rang.			v.	-	v.	-
Rang.	II.	-	III. Almerase	(2)	III. Tonalase	(155)
Sub-rang.	i.	-	i. (*Urallaose*)	(0)	i.	-
Sub-rang.			ii.	-	ii. *x*	(3)
Sub-rang.	ii.	-	iii. *Almerose*	(1)	iii. Harzose	(26)
Sub-rang.	iii.	-	iv. Sitkose	(1)	iv. Tonalose	(117)
Sub-rang.			v.	-	v. Placerose	(9)
Rang.	III.	-	IV. *x*	(3)	IV. Bandase	(36)
Sub-rang.	i.	-	i. *x*	(1)	i. Sagamose	(2)
Sub-rang.	ii.	-	ii.	-	ii. *x*	(8)
Sub-rang.	iii.	-	iii. *x*	(2)	iii. Bandose	(26)
Rang.			V. Gordonase	(1)	V.	-

Of the nine analyses quoted five fall into the sub-rang Almerose. In this subdivision Washington gives only one analysis, that of a cordierite andesite from Almeria, in Spain. Eleven analyses are given in sub-rang Riesenose, that to which the obsidianites from Peake Station and Hamilton belong, but (Urallaose) is unrepresented and (Piemanose) is only represented by a segregation in granite. For the sake of comparison the following analyses are given. They are taken from Washington's tables of analyses. In the first column of each analysis is shown the percentage of each oxide, and in the second column is shown the molecular proportion :—

	I.		II.		III.	
SiO_2 -	63.75	1.063	77.27	1.288	68.87	1.148
Al_2O_3 -	17.62	.173	9.98	.098	16.42	.161
Fe_2O_3 -	3.00	.019	2.58	.016	1.91	.012
FeO -	3.26	.045	.41	.005	2·06	.029
MgO -	3.41	.085	.51	.013	2.54	.064
CaO -	2.50	.045	2.28	.041	4.64	.083
Na_2O -	1.75	.030	2.14	.034	1.25	.020
K_2O -	2.40	.025	2.39	.024	1.10	.012
TiO_2 -			tr.			
MnO -			.99	.014		
H_2O -	2.77		.86		1.12	
Total -	100.45		99.41		99.91	

I.—Almerose. Cordierite andesite, Hoyazo, Cabo de Gata, Almeria, Spain.

II.—Riesenose. Granite, Wengenweise, Henweg, Hesse.

III.—(Piemanose). Schliere in granite, Vorderberg, Riesengebirge, Silesia.

The norms for these rocks are:—

	I.	II.	III.
Quartz - -	31.9	50.6	42.5
Orthoclase - -	13.9	13.9	6.7
Albite - -	15.7	17.8	10.5
Anorthite - -	12.5	10.8	23.1
Corundum - -	7.4	.3	4.7
Hypersthene -	12.0	1.3	8.6
Magnetite - -	4.4	1.2	2.8
Hematite - -		1.7	

As a result of the classification of the analyses of obsidianites, we are now in a position to compare these analyses critically with one another, and also with other analyses. It is self-evident that there is a strong family resemblance between all nine analyses. Most of the obsidianites, as already stated, belong to the group Almerose, and the others do not diverge greatly from this type. The subdivision Riesenose, though belonging to a higher class than Almerose, still falls into the corresponding Order, Rang and Sub-rang, the only difference being that the higher percentage of silica and lower percentage

of magnesia and iron cause the total of the salic minerals in this case to be more than seven times the femic minerals.

The Uralla analysis corresponds closely to the other analyses, and would fall into the group Almerose, but for the almost entire absence of soda. It will be seen that the total alkalis are about normal, and it is to be hoped that more analyses of buttons from this area may be made to determine if this result be in accord with others from the same locality.

The analyses of the specimen from Pieman wanders farthest from the type group. The large excess of lime over the alkalis throws this analysis into Rang IV., otherwise it is fairly closely related to Riesenose.

The division line between Class I. and Class II. is necessarily an arbitrary one, so that with an increase in the number of analyses of obsidianites we should probably get a perfect gradation from Riesnose to Almerose. Even as it is we see that some of the analyses belonging to the Almerose Sub-rang seem to be more nearly related to the analysis of the Hamilton specimen than to other analyses falling into the same group as themselves.

By far the most important result of the classification of the analyses is, however, to demonstrate clearly that rocks having compositions similar to those of the obsidianites are rarely met with among the igneous rocks of the earth's surface. The importance of this result becomes very evident when we come to consider the origin of the obsidianites.

The Origin of Obsidianites.

Several hypotheses have been advanced to account for the origin and distribution of obsidianites, and naturally their chemical composition has an important bearing on the solution of the problem. It has been stated:—

(a) They are artificial products.
(b) They represent a peculiar form of volcanic ejectmenta.
(c) They are meteoritic in origin.

(a) *Artificial Products.*—

At first sight the general appearance of obsidianites may incline one to the belief that they are artificial in origin, but a

consideration of the chemical composition shows that such a belief is untenable. The analyses show that if the obsidianites be artificial, they must have come from a common source, and are either the result of the melting down of some substance having the requisite chemical composition, or else are the products of high-class metallurgical works. The occurrence of the buttons over such a large area shows that the distribution from this common source must have commenced long before the discovery of Australia, so that to believe in the artificial origin of obsidianites we must believe that among the Australian aborigines were first-class metallurgical chemists who had control of temperatures of over 1300 deg. C.

(b) *Volcanic Products.*—

Most of the earlier writers on this subject believed that the obsidianites were a peculiar form of volcanic bomb, and this opinion is still held by many. Various places, such as the volcanoes of New Zealand, South Victoria Land, and the Malay Archipelago, and the extinct volcanoes of Victoria, have been named as the source from which the bombs were derived. Unfortunately, no reliable analyses of Victorian basalts have been recorded, but analyses of rocks from the other areas are given below, together with the analyses of the Coolgardie obsidianite for convenience in comparison. Only the more important constituents are quoted.

	I.	II.	III.	IV.
SiO_2	70.62	75.46	68.51	57.95
Al_2O_3	13.48	11.27	15.96	20.43
Fe_2O_3	.85	1.17	2.61	3.43
FeO	4.44	2.05	1.09	1.35
MgO	2.42	.27	1.07	.26
CaO	3.09	.53	3.14	1.90
Na_2O	1.27	3.45	4.01	8.32
K_2O	2.22	4.88	1.82	5.96
H_2O+	.01	.28	n. d.	.39
H_2O-	.06	.07		.23
TiO_2	.90	.05	.82	.40
MnO	.42	tr.	.28	.07
Total	99.75	99.93	100.65	100.76
Sp. Gr.	2.454	2.353	2.329	?

I.—Obsidianite from near Coolgardie, Western Australia.

II.—Obsidian from Mayer's Island, New Zealand. Analysed by P. G. W. Bayly.—Records of the Geol. Survey of Victoria, Vol. II., Part 4, 1908, p. 205.

III.—Andesitic Pumice from Krakatoa Eruption, 1883. Analysed by G. Winkler. Washington, Chemical Analyses of Igneous Rocks, p. 193.

IV.—Phonolitic Trachyte from top of 900 ft. knoll, Mt. Terror, South Victoria Land. National Antarctic Expedition, 1901-1904. Natural History, Vol I., Geology, pp. 114, 119.

The norms corresponding to these analyses are:—

	I.	II.	III.	IV.
Quartz	41.0	35.5	29.9	
Orthoclase	13.4	29.0	11.1	35.0
Albite	11.0	29.3	33.5	36.0
Anorthite	15.3	.6	15.6	.8
Nephelite				18.5
Corundum	3.3		1.6	
Diopside		1.7		1.5
Hypersthene	13.0	2.5	2.7	
Wollastonite				2.8
Magnetite	1.1	1.6	1.2	3.5
Ilmenite	1.7	0.2	1.5	.8
Hematite			1.7	1.0

From these results we obtain the following classification:—

	CLASS.	ORDER.	RANG.	SUB-RANG.
I.—	II. Dosalane	III. Quarfelic Hispanare	III. Alkali-calcic Almerase	III. Sodi-potassic Almerose
II.—	I. Persalane	III. Quarfelic Columbare	I. Peralkalic Alaskase	III. Sodi-potassic Alaskose
III.—	I. Persalane	IV. Quardofelic Brittanare	III. Alkali-calcic Coloradase	IV. Dosodic Yellowstonose
IV.—	I. Persalane	VI. Lendofelic Russare	I. Peralkalic Miaskase	IV. Dosodic Miaskose

The analysis of the New Zealand obsidian is that of a fairly normal acid glass, in which the sum of the alkalis very greatly exceeds the lime. Other analyses of New Zealand rhyolitic rocks quoted by Washington are found to be closely related to that of the Mayer Is. specimen.

All the analyses of acid and intermediate rocks from South Victoria Land recorded by Dr. Prior are found to be closely related to one another, and the analysis quoted may be taken as fairly representative.

Very few analyses of recent volcanic rocks from the Malay Archipelago are recorded, the one given above being the only superior analysis of material from this area, quoted by Washington.

An examination of the foregoing results should prove conclusively that there is no chemical relationship between the obsidianites and the rocks quoted, and therefore the chemical evidence at present available is entirely opposed to the possibility of New Zealand, South Victoria Land or Malay Archipelago being the sources of the obsidianites.

Although no reliable analyses of Victoria basalts have been recorded, numerous micro-sections have been examined, and there is no evidence of any departure from a normal composition, and as they are all basic in character, the obsidianites cannot possibly be glassy representatives of these rocks. Mr. Dunn[1] suggests that the obsidianites may have preceded the basaltic flows, but this is impossible in some cases, as the buttons are often found resting on the surface of the lava flows. In some areas it has been shown[1] that a gradual change has taken place in the composition of the lava poured out by the volcanoes of that area, the result being that whereas the earliest flows were basaltic, the final products were more closely allied to obsidian.

Even if we disregard the almost unique composition of the obsidianites, we are not justified in assuming that they represent any such acid residuum from a basic magma, for if acid differentiation products were formed we should certainly find some traces of them in or around some of the extinct cones.

It would seem, therefore, that the advocates of a volcanic origin for the obsidianites receive no support from a consideration of their chemical composition.

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1 Records of the Geol. Survey of Victoria, vol. ii., pt. IV., 1908, p. 204.

1 Geikie's Text Book of Geology, pp. 137, 349, 708.

(c) *Meteoritic Origin.*—

Before discussing what bearing the chemical composition of the obsidianites has to the meteoritic hypothesis of their origin, some account of their distribution from a chemical standpoint is necessary.

Referring back to the table of analyses, it will be seen that the specific gravity practically varies inversely as the percentage of silica. By determining the specific gravity of a specimen, therefore, we have a quick method of arriving at its approximate composition. On receiving Mr. Ampt's analysis of the Peake Station obsidianite, I was struck by the extremely low specific gravity (2.385) of this specimen, no other recorded determination being less than 2.41. I therefore set to work to carefully determine the gravity of some of the specimens at my disposal. All buttons were carefully cleaned and scrubbed with dilute hydrochloric acid, and after being washed and dried, were weighed on a chemical balance. They were then boiled in distilled water to get rid of every trace of surface air bubble, and on cooling were re-weighed in water. Six determinations were made of buttons from Hamilton, from Balmoral, and from Peake Station. The results are given below, together with six specific gravities recorded by Mr. Simpson of obsidianites from Kalgoorlie.

	I.	II.	III.	IV.
1.	2.395	2.389	2.376	2.43
2.	2.398	2.401	2.376	2.43
3.	2.401	2.401	2.389	2.45
4.	2.401	2.406	2.406	2.45
5.	2.401	2.413	2.414	2.46
6.	2.406	2.455	2.436	2.49

I.—Six small specimens from near Hamilton.

II.—Six small specimens from Balmoral.

III.—Six large specimens from Lake Eyre District.

IV.—Six specimens from Kalgoorlie.

Mr. Kerr Grant determined the bulk specific gravity of sixty-nine specimens from the Lake Eyre District, and kindly furnished me with the result obtained, viz., 2.395.

The above results are extremely interesting, as they point to

a certain amount of provincial distribution of the obsidianites. It will be seen that the average specific gravity of the Hamilton specimens is 2.400, and Mr. Simpson gives 2.448 as the average specific gravity of the specimens determined by him. Judging from the above values, it seems that the Lake Eyre District and Western Victoria are characterised by a more acid type of obsidianite than Kalgoorlie District.

For convenience in recording the distribution of the different types, I would suggest the following divisions, according to specific gravity:—

A.—Under 2.390. Peake Station type. Analysis No. III.
B.—2.391—2.410. Hamilton type. Analysis No. II.
C.—2.411—2.440. Mt. Elephant type.[1] Analysis No. I.
D.—2.441—2.470. Kalgoorlie type. Analyses Nos. IV., V., VI., VIII.
E.—Over 2.470. (?) type.[2] No analysis.

The gravities recorded in this paper give the following results:—

Hamilton	6B.
Balmoral	1A, 3B, 1C, 1D.
Peake Station	3A, 1B, 2C.
Kalgoorlie	2C, 3D, 1E.

I hope in time to collect a sufficient number of records of specific gravities to thoroughly test this apparent distribution according to chemical composition.

Judging from records taken from Mr. Walcott's paper, viz., Clarke, 2.42—2.7; Stelzner, 2.41—2.52; Twelvetrees and Petterd, 2.45—2.47; and Walcott, 2.42—2.48, it seems that the Peake Station and Hamilton types are rarely met with, except in the type localities. As, however, these are the prevailing types about Lake Eyre and part of Western Victoria, it appears that we certainly have two areas on which the more acid type fell most abundantly, whereas about Kalgoorlie nothing but the more basic types are recorded.

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1 The Mt. Elephant analysis is taken as the standard as it is more normal than the Pieman analysis.

2 The Uralla specimen may belong here, but unfortunately no specific gravity is recorded.

What little evidence we have, therefore, strongly supports this idea of provincial distribution, and if on further work this is upheld, the cosmic origin of obsidianites is practically determined, because such distribution is impossible by means of any of the agencies suggested by the advocates of a volcanic or artificial origin. The agencies which have been suggested are water, ice, aborigines, birds, winds, volcanic explosions and hypothetical bubbles. It is quite inconceivable that chemical distribution could be effected by any of these means.

The two principal arguments against the meteoritic hypothesis are—the form and the composition of the obsidianites. This paper is only concerned with the latter. It has been argued that obsidianites cannot be meteoritic in origin, because they differ so completely in composition from all known meteorites. The stony meteorites are all extremely basic in composition. This argument cuts both ways, however, for we may with quite as much justification say that as the obsidianites do not agree in composition with terrestrial rocks, they are therefore extra-terrestrial.

As the artificial origin is impossible, and as none of the suggested volcanic sources have produced lavas at all agreeing in composition with that of obsidianites, these two hypotheses appear untenable. This leaves us the meteoritic hypothesis, and the almost unique composition of the obsidianites, together with their apparent provincial distribution, makes it practically certain that this is the correct explanation of the origin of these interesting substances.

Billitonites and Moldavites.

Dr. Suess[1] quotes three analyses of billitonites, but only two are sufficiently complete for purposes of classification. The analyses, with their molecular proportions, are as follows :—

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1 Die Herkunft der Moldavite und verwandter Glaser. Jahrb. d. k. k. geol. Reichsanst Vienna, 1900, vol. 50.

	I.		II.	
SiO_2	70.92	1.182	71.14	1.186
Al_2O_3	12.20	.120	11.99	.117
Fe_2O_3	1.07	.007		
FeO	5.42	.075	5.29	.073
MgO	2.61	.065	2.38	.059
CaO	3.78	.068	2.84	.051
Na_2O	2.46	.040	2.45	.039
K_2O	2.49	.027	2.76	.029
MnO	.14	.002	.32	.005
Total	101.09		99.17	
Sp. Gr.	2.447		2.43	

I.—Billitonite from Tebrung, Dendang. Analysed by C.v. John.

II.—Billitonite from Lura Mijn, No. 13, Dendang. Analysed by Dr. Brunck.

The following are the norms. calculated from these analyses:—

	I.	II.
Quartz	31 4	32.0
Orthoclase	15.0	16.1
Albite	21.0	21.0
Anorthite	14.7	13.6
Diopside	3.4	.7
Hypersthene	14.0	15.8
Magnetite	1.6	

Both of these analyses fall into the sub-rang. Almerose, and although differing somewhat from the obsidianites which fall into this group the general resemblance is very marked.

Six analyses, quoted by Dr. Suess, of Moldavites are capable of classification. All these analyses were made by C. v. John, Vienna.

	I.	II.	III.	IV.	V.	VI.
SiO_2	77.69	82.28	77.75	77.96	82.68	78.61
Al_2O_3	12.78	10.08	12.90	12.20	9.56	12.01
Fe_2O_3	2.05			.14		.16
FeO	1.45	2.03	2.60	3.36	1.13	3.06
MgO	1.15	.98	.22	1.48	1.52	1.29
CaO	1.26	2.24	3.05	1.94	2.06	1.62
Na_2O	.78	.28	.26	.61	.63	.44
K_2O	2.78	2.20	2.58	2.70	2.28	3.06
MnO				.10	.18	.11
Loss on ignition		.06	.10			
Total	99.94	100.15	99.46	100.49	100.04	100.49

I.—Moldavite from Radomilitz, near Budweis (Light brown).
II.—Moldavite from Radomilitz, near Budweis (Light green).
III.—Moldavite from Radomilitz, near Budweis (Dark green).
IV.—Moldavite from Tribitsch.
V.—Moldavite from Budweis (Light green).
VI.—Moldavite from Tribitsch.

The norms. are as follow:—

	I.	II.	III.	IV.	V.	VI.
Quartz - -	57.3	63.8	57.5	54.6	62.6	56.8
Orthoclase - -	16.7	13.3	15.0	16.1	13.3	17.2
Albite -	6.8	2.6	2.1	5.2	5.2	3.7
Anorthite - -	6.4	11.1	15.3	9.9	10.3	8.1
Corundum - -	6.0	3.1	4.0	4.7	2.3	5.2
Hypersthene -	3.8	6.2	5.4	10.0	6.3	9.3
Magnetite - -	3.0			.2		.2

The sub-rangs. into which these analyses fall are:—

I.—(Radomilitzose).
II.—(Moldavose).
III.—(Budweisose).
IV.—(Moldavose).
V.—(Moldavose).
VI.—(Moldavose).

It will be seen that the composition of the moldavites differs considerably from that of the obsidianites. In this case, again, we have almost unique compositions such as are rarely met with among the igneous rocks of the earth. Dr. Suess strongly upholds the cosmic origin of these bodies, and also of the billitonites and australites=obsidianites.

Summary and Conclusions.

Six recorded and three new analyses of obsidianites are brought together and compared by means of the American classification of igneous rocks.

It is shown that the analyses indicate compositions rarely met with among terrestrial rocks.

The artificial origin of obsidianites is shown to be chemically impossible.

Analyses of rocks from the various places named as possible sources of the obsidianites, are compared with the analyses of the obsidianites and it is shown that there is nothing in common between them.

It is pointed out that there is an apparent provincial distribution of obsidianites, and if this is proved to be correct, it is shown that a cosmic origin is the only possible one.

Analyses of billitonites are given and classified, and shown to be genetically connected with the obsidianites.

Six analyses of moldavites, when classified, are found to have few representatives among terrestrial rocks, and the argument in favour of a cosmic origin for them is strengthened.

APPENDIX.

The following additional information has come to hand since the above paper was read:—

New Zealand.—In answer to a letter inquiring about the occurrence of obsidianites in New Zealand, Dr. Marshall wrote:—"I think I can say without any qualification that there is no record whatever of the occurrence of such objects in New Zealand. Of course you are aware that obsidian, as a rock, occurs at many localities, notably at Mayor Island, Rotorua, and near Whangaroa, but even in these districts I have seen no obsidian bombs, to say nothing of obsidianites."

Queensland.—Mr. Dunstan, Government Geologist of Queensland, informed me that they had often inquired about the occurrence of obsidian bombs in Queensland, but could get no specimens, and, further, had not heard of any being found.

New South Wales.—Mr. Card called my attention to the record of obsidianites in the Records of the Geological Survey of New South Wales, Vol. VII., Pt. III., p. 218. Four specimens are figured. At the same time he told me that Mr. Mingaye was not satisfied with the analysis of the Uralla obsidianite, as he had very little material to work on, and intended analysing another specimen from the same locality.

South-Western New South Wales.—The following is the record of the specific gravities of twenty obsidianites obtained by Mr Milo R. Cudmore, from a station situated 185 miles north-west of Wentworth, New South Wales, and 120 miles east of Kooringa, South Australia:—

2.439	-	2.421	-	2.417	-	2.408
2.439	-	2.419	-	2.415	-	2.407
2.433	-	2.419	-	2.415	-	2.401
2.432	-	2.419	-	2.415	-	2.391
2.431	-	2.418	-	2.414	-	2.389

Average specific gravity—2.417.

Tasmania.—Mr. W. F. Pettard has kindly forwarded me a pamphlet on the minerals of Tasmania, prepared for the use of the members of the Australasian Association for the Advancement of Science, during the last meeting in Tasmania. In this Mr. Pettard states that he is of opinion that a meteoritic shower of obsidianites occurred in post-pliocene time, which impinged upon the earth in a north-western track, crudely extending from Tasmania to Victoria, from thence to the northern part of West Australia, and thence to the western islands of the Malay Archipelago.

LITERATURE.

1896—Moulden, J. Collett: Petrographical Observations upon some South Australian Rocks. Trans. Roy. Soc. S. Australia, vol. 19, p. 77.

1897—Stephens, T.: Notes on a Specimen of Basaltic Glass (Tachylyte), from near Macquarie Plains, Tasmania, with Remarks on Obsidian Buttons. Papers and Proc. Roy. Soc. Tasmania for 1897, p. 55.

1898—Walcott, R. H.: The Occurrence of So-called Obsidian Bombs in Australia. Proc. Roy. Soc. Victoria, vol. xi. (n.s.), pt. i., p. 23.

1898—Card, G. W.: Annual Report of the Curator and Mineralogist. Ann. Rep. of Dep. of Mines and Agriculture for N.S. Wales for 1907, pp. 190, 197.

1898—Krause, P. G.: Obsidianbomben aus Niederlandisch-Indien. Sammlungen des geologischen Reichsmuseum, Leiden. Series i., vol. v., p. 237.

1898—Suess, Franz. E.: Ueber den kosmischen Ursprung der Moldavite. Verhandl. d. k. k. geol. Reichsanst., 1898, p. 387.

1900—Suess, Franz E.: Die Herkunft der Moldavite und verwandter Glaser. Jahrb. d. k. k. geol. Reichsanst, vol. 50, p. 193.

1902—Simpson, E. S.: Notes from the Departmental Laboratory. West Australian Geol. Survey. Bull. 6, p. 79.

1903—Pettard, W. F.: The Minerals of Tasmania, p. 6.

1904—Card, G. W.: Mineralogical Notes, No. 8. Rec. of Geo. Surv. of N.S. Wales, vol. vii., 1900-1904, pt. 3, p. 218.

1905—Twelvetrees, W. H.: Record of Obsidianites or Obsidian Buttons in Tasmania. Ann. Rep. of the Sec. for Mines, Tasmania, for 1905, p. 20.

1906—Armitage, R. W.: Natural History Notes—Obsidian Bombs. The Victorian Naturalist, vol. xxiii., No. 5, p. 100.

1908—Dunn, E. J.: Rock and Mineral Analyses. Ann. Rep. of the Sec. for Mines, Victoria, for 1907, p. 63.

1908—Dunn, E. J.: Obsidian Buttons. Rec. of Geol. Surv. of Victoria, vol. ii., pt. 4, p. 202.

For record of earlier Literature, reference should be made to the papers by Mr. R. H. Walcott and Dr. Suess.

[PROC ROY. SOC. VICTORIA, 21 (N.S). PT. II., 1908].

ART. XIX.—*Obsidianites—Their Origin from a Physical Standpoint.*

BY KERR GRANT, M.Sc.

[Read 8th October, 1908].

The objects known as "Obsidianites" are apparently peculiar to the Australian continent; but are allied to the "Moldavites" of Bohemia and the "Billitonites" of Malay Archipelago. All three forms are sharply distinguished from other natural mineral forms by their physical and chemical character, and mode of occurrence.

"Obsidianites" have been well described and discussed by R. H. Walcott,[1] and all three forms very completely by Franz Suess in an exhaustive Monograph on "Moldavites and Allied Glasses."[2] Both papers give Bibliographies of the extensive literature on the subject.

The theories which have been advanced to account for the occurrence of these objects may be divided into three groups:—

(1) Those which assign to them an artificial origin.

(2) Those which regard them as natural and terrestrial in origin.

(3) Those which regard them as natural and extra-terrestrial.

The first theory has, in the case of Obsidianites, nothing to support it, and very obvious and powerful arguments to oppose it. A theory of natural origin has to explain, in the first place, the physical and chemical characters, and in the second the mode of distribution of the Obsidianites. On both these grounds there are great difficulties in the way of accepting a terrestrial origin. In particular the occurrence of these objects hundreds of miles from any region of volcanic activity has been regarded

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1 Proc. Roy. Soc. Victoria, n.s., II., 1898, p. 23.

2 Jahrbuch der k.k. geol., Reichsanstalt, 1900.

as fatal to an explanation of their production by volcanic agency. This has occasioned Mr. E. J. Dunn to put forward an hypothesis as to their mode of distribution from volcanoes.[1] Mr. Dunn suggests that the Obsidianites are the "blebs of obsidian bubbles."

Apart from the general arguments against a terrestrial origin which have been put by Walcott, Suess, and other writers, there are certain others special to Mr. Dunn's hypothesis which appear to me to render it quite untenable.

(1) The forms of the obsidian buttons are not, with a few possible exceptions, those which a liquid drop assumes when hanging from a bubble. The formation of the frequently occurring "dumb-bell" type by the union of two separate bubbles is quite inadmissible. If the bubbles, and a fortiori the blebs, were perfectly liquid, the two latter would certainly coalesce to a drop of circular horizontal section; if they were not perfectly liquid we should expect signs of discontinuity at the junction: such do not occur. Mr. Dunn considers that the form figured by him in Fig. 45 of his paper was attached to the original supporting bubble around the projecting rim. There are, however, no signs of fracture around the rim such as we would expect had the obsidianite broken away from the parent bubble, nor have I been able to find such signs in any one of the numerous other specimens with rims which I have carefully examined. The specimen figured by Mr. Dunn is one of very unusual type, and the commoner forms will not afford even its frail support to his ingenious hypothesis. For instance, in Professor Spencer's Central Australian collection are many specimens without the bubble-suggesting rim at all.

(2) A more conclusive objection is the following:—

The pressure within a liquid bubble is determined by the total curvature of its inner surface (and, of course, the surface-tension of the liquid). It is evident, without exact investigation, that one part of the interior cannot be convex while another is concave. But as both upper and lower surfaces of the obsidianites are invariably convex, it is obvious that the attachment of the "bleb" to the bubble in the way imagined by Mr. Dunn is a physical impossibility.

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1 Rec. Geol. Survey of Victoria, vol. ii., pt. IV.

(3) In order that a spherical bubble of glass, vacuous, let us suppose, within, should float in air, its thickness must not be more than a certain fraction, approximately .00017, of its radius. In order that it should not collapse under the air-pressure its thickness, on the other hand, must be not less than another definite fraction, approximately .00024, of its radius. It is impossible, therefore, for a glass-bubble, vacuous within and strong enough to withstand air-pressure, to float in air. This conclusion I have been able to verify experimentally.

The case is obviously worse for the obsidian bubbles with their heavy blebs attached, of Mr. Dunn's hypothesis; unless, indeed, Mr. Dunn imagines them to have been blown with hydrogen or helium!

Although other objections may be brought against the "Bubble-theory" of the origin of obsidianites, the above are, I think, sufficient to show its extreme improbability; and since no other plausible explanation of their mode of distribution has yet been advanced by the advocates of the terrestrial theory, we are driven to explain their occurrence by means of a meteoritic hypothesis.

It has been objected that on this hypothesis such objects would be found scattered over the whole land-surface of the earth, and not confined to three comparatively small areas. This objection would be at least equally valid against any volcanic theory of origin, unless it could be established that the volcanoes of those parts of the world where obsidianites occur bear a character distinct from those of the remainder. I am not aware that anyone has attempted to show this.

Nor is the objection at all dangerous to the meteoritic theory. The virtual identity of chemical and physical properties in all obsidianites, as also in the Moldavites and Billitonites, strongly suggests, not merely a similar, but the same parentage; production, in fact, not by a long-continued succession of meteoric falls, but in a single meteor shower. This hypothesis would well account for the confinement of each species to a relatively small and well-defined area on the earth's surface; and to push it a step further it may be suggested as a possibility that the three swarms above-named have been produced in successive returns of the same meteor-shower.

The physical characteristics of Obsidianites accord well with the hypothesis of their meteoric production.

The average velocity of meteors which enter the atmosphere may be taken as about 40 miles per second. If only one per cent. of the energy which such meteors possess were, under the influence of air-friction, converted into heat and retained by the body, it would probably be sufficient to raise the substance of an obsidianite to the melting point and render it completely liquid. The melting-point of the material and its specific heat have been determined in the Physical Laboratory, Melbourne University, as 1324 deg. C. and .21 respectively. The remarkably homogeneous quality of the glass of which obsidianites are composed renders it certain that they have, prior to assuming their present form, been fused throughout.

The forms which a mass of liquid motion is capable of assuming have been the subject of discussion by many eminent mathematicians from the time of Newton to the present day. Neglecting the effect of air-resistance on the surface it has been shown that the following forms are possible:—

(1) The sphere—possible only when there is no rotation.
(2) The oblate spheroid—stable at low speeds of rotation.
(3) The prolate spheroid—stable, if at all, only at high speeds of rotation.
(4) The apioid, or pear-shaped figure of revolution.
(5) The dumb-bell or hour-glass figure of revolution.

It is remarkable that all these forms, if we ignore secondary features, are comprised among those assumed by Obsidianites. The occurrence of cigar-shaped and dumb-bell shaped figures is of particular interest since the stability of these types is still a matter of dispute among mathematicians.

The secondary features of form alluded to consist of the well-known rim, the ripples concentric with it on one face and the smaller pittings and furrowings of the surface. These features have been satisfactorily explained as due to the action of the air on the moving liquid, and Suess has succeeded in obtaining artificial pittings, etc., by the action of jets of steam on rotating lumps of resin.

I have also observed on two specimens markings which have strongly the appearance of having been produced by the impact of the glass, while still plastic, on some hard object.

Both primary and secondary features of form, therefore, while they do not negative a terrestrial origin, accord at least equally well with an extra-terrestrial.

It is much to be regretted that the few hollow specimens of Obsidianites which have been found have been cut open without the collection of the contained gas, an analysis of which would probably throw light on the true nature of the objects. The author would be much indebted to any person possessing an obsidianite of specific gravity lower than 2.38, which would probably indicate cavities inside, who would communicate with him.

[PROC. ROY. SOC. VICTORIA, 21 (N.S.), PT. II., 1908.]

ART. XX.—*Description of a New Species of Sminthopsis.*

BY W. BALDWIN SPENCER, C.M.G., M.A., F.R.S.

I am indebted to Mr. G. A. Keartland for the specimen upon which the following description is based. Though there is only one, it is an adult male, and differs so clearly from all known species of Sminthopsis that I have no hesitation in describing it as new.

Sminthopsis longicaudatus, sp. n.

Size of body similar to that of *S. leucopus*. A darkish line along each side of the face through the eye. Upper and lower lips and chin white. General body colour grey with rufous tinge in parts; the basal three-quarters of each hair blue-black. Fore-arm, hand and foot white.[1]

Ear large and broad; laid forward they reach the anterior canthus of the eyes.

Hand with six pads, four smaller distal ones corresponding in position with the intervals between the digits 1 and 2, 2 and 3, 3 and 4, 4 and 5. Two large proximal ones near the wrist. Both of the latter are V-shaped, with the apex pointing forwards. The one on the outer side is large. All the pads are striated.

Foot with five pads, three at the base of the digits, one at the base of the hallux, and one further back. All the pads are striated. Both palms and soles are finely granulated.

Tail remarkably long—twice the length of the head and body; scaly, with short stiff hairs; no crest; composed of some 30 elongate vertebral bodies.

Skull.—Slender and delicate. The nasals proportionately longer than in any other species, and but very slightly broader behind than in front. Interorbital space smooth; no postorbital

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1 Owing to the imperfect preservation of the fur it is not possible to describe the colours more in detail.

process. Lambdoidal crest not strongly developed. Anterior palatine foramen extending back slightly beyond the level of the hinder edge of the canine. Posterior palate with large regular-shaped vacuities, each as long as the first three molars, and a second pair at the hinder end of the palate extending backwards beyond the hinder edge of the last molar. Bullae of considerable size, the mastoid as well as the alisphenoid part being distinctly swollen.

Upper incisors small, the first cylindrical, i^2 i^3 and i^4 distinctly flattened; i^4 slightly the largest. Upper canine comparatively small, flattened, not projecting beyond the limit of the last p.m. with a small anterior and distinct posterior cusp. Upper p.ms. increasing regularly in size from before backwards; p^4 not twice the size of p^1. Lower incisors small, but the first one decidedly larger than the other two. Canines with slight but distinct posterior basal cusp. Three p.ms. evenly increasing in size backwards.

Body Measurements.

Length, head and body	100
Tail	202
Hind foot	18
Forearm and hand	28
Ear	15
Head	35
Muzzle to eye	14
Lower leg	27
Heel to front of large sole pad	15

Skull Measurements.

Basal length	27
Greatest width	17
Nasal, length	12
Nasal, greatest breadth	2.3
Nasal, least breadth	1.9
Intertemporal breadth	6
Palate, length	16

Palate, breadth between outer corners of m^3	9
Palatal foramina	3.5
Basi-cranial axis	9
Basi-facial axis	18
Facial index	200
Teeth, vertical height upper canine ...	1.5
„ horizontal length p^4	1.5
„ length, $ms^{1\text{-}3}$	5
„ breadth, m^4	2

Habitat.—West Australia.

Type in National Museum, Melbourne.

In general form of body this species is a typical *Sminthopsis*, calling to mind *S. leucopus*. It differs from a small *Phascologale* in the general lightness of its build and the length of snout and feet, and from all known species of *Sminthopsis* in the extraordinary length of its tail, which is longer in proportion than in *Antechinomys*, from which, again, it differs in the relative length of the hind limbs.

PROC. ROY. SOC. VICTORIA, 21 (N.S.), PT. II., 1908.]

ART. XXI.—*On the Occurrence of the Selachian Genus Corax in the Lower Cretaceous of Queensland.*

BY FREDERICK CHAPMAN, A.L.S., &c.

National Museum.

(With Text Figure).

[Read 10th December, 1908.]

Introductory Remarks.—Already two species of sharks' teeth have been recorded from the Lower Cretaceous (Rolling Downs Formation) of Queensland by Mr. R. Etheridge, junr. They are represented by a tooth[1], referred to *Lamna appendiculata*, Agassiz, and seven conjoined vertebrae[2], described under the name of *Lamna daviesii*. Up to the present, apparently, no example of the truly Cretaceous genus *Corax* had been observed.

The specimen herein described occurs on a weathered slab of limestone, the surface of which is crowded with fragments of fish-remains and a small *Belemnite*, possibly allied to *B. diptycha*, McCoy. The other fish-remains noticed seem to belong to an indeterminate ganoid genus, shown by the presence of polished scale-fragments, awl-shaped teeth and small vertebrae. This interesting fossiliferous limestone specimen was presented to the Museum by G. H. Roche, Esq., who had obtained it from H. A. C. Webb, Esq., its discoverer. The locality of the specimen is the Hamilton River, about 40 miles from Boulia, Queensland.

Description.—This specimen is evidently a young tooth, since the point of the crown is much depressed and acute. The base of the tooth is large in proportion, a characteristic of *Corax*, and is broadly wedge-shaped, tapering to the lower margin. There is no indication of an internal cavity to the tooth, as in *Lamna* and other allied genera. The anterior coronal margin is flexuous, and the depressed point makes it to be almost parallel with the

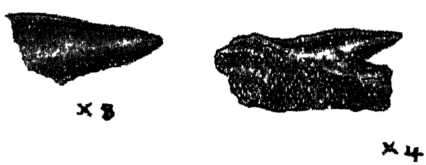
1 R. Etheridge, Jnr., in Etheridge and Jack's Geol. and Pal. of Queensland and New Guinea, 1892, pp. 503, 504.

2 Op. supra cit., p. 503.

basal margin of the root. It is the inner surface of the tooth which is exposed on the slab, and it is highly convex. The anterior and posterior coronal margins are depressed and flanged, and under magnification the edges are seen to be feebly crenate.

Dimensions.—Length of root, 5.5 mm.; entire length of crown, 6 mm.; height of root, 2 mm.; height of crown from upper limit of root, 1.25 mm.

Remarks.—The genus *Corax* is typically an Upper Cretaceous fossil,[1] but one species, *Corax antiquus*, Deslong., has been described from the Lower Oolite of Normandy.[2] In its somewhat depressed form and inconspicuous serrated margins the present example most nearly resembles *C. affinis*, Agassiz,[3] from the Upper Cretaceous (Danian and Upper Senonian) of Europe. Agassiz's figures of *C. appendiculatus*[4] also closely resemble our specimen, a form regarded by Smith Woodward as synonymous either with *C. pristodontus*, Ag., or *C. affinis*, Ag.[5] In *C. affinis*, however, there is generally a broad posterior denticle near the base of the coronal margin, which is entirely absent in the Australian specimen. Upon these grounds it seems advisable to keep the Australian form as a distinct species, also taking into consideration the fact that it occurs in a rock of an older division of the Cretaceous. It may therefore be referred to under the name of *Corax australis*.



Corax Australis, sp. nov.

Lower Cretaceous, Hamilton River, Queensland.

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1 See Smith Woodward, Catalogue Foss Fishes (Brit. Mus.), 1889, pp. 422-429.

2 Deslongchamps, Le Jura Normand, Mon. vi., 1877, p. 4, pl. i., figs. 4, 5.

3 Agassiz, Poiss. Foss., vol. iii., 1843, p. 227, pl. xxvia, figs. 21-34. Smith Woodward, op. cit., p. 427. Idem, Proc. Geol. Assoc., vol. xiii., 1895, p. 199, pl. vi., figs. 19-22.

4 Agassiz, op. cit., pl. xxvia, figs. 16-20.

5 Smith Woodward, op. cit., p 423 (footnote).

Proc. Roy. Soc. Victoria, 21 (N.S.), Pt. II., 1908.]

Art. XXII.—*The Endoparasites of Australian Stock and Native Fauna.*

Part I.

Introduction, and Census of Forms recorded up to date.

By GEORGINA SWEET, D.Sc., Melb. Univ.,

Government Research Scholar.

[Read 10th December, 1908.]

Introduction.

The investigation of which the present papers form the first records was begun this year (1908) in the Biological Laboratory of the University of Melbourne. This work, of which the extent and difficulties can only be appreciated by those who know something of the subject, aims at making a systematic and thorough enquiry into the nature of the internal parasites infesting Australian animals, both native and domesticated, and then into the life-history and conditions of increase and spread of these injurious forms. So far but little of a methodical and widespread nature has been done in Australia, although, as will be seen from the accompanying census, a considerable number of records are scattered about in various publications. The valuable work of Dr. N. A. Cobb in New South Wales is the principal series of records in this direction, the other States of the Commonwealth being very far behind the mother State in this respect. This, in a country so dependent on its live stock industries as Australia, means a very great loss in revenue annually from what are probably preventable causes.

Doubtless we have here many of the more common forms of the older civilised countries, which have been introduced, but very probably, too, there are species unknown elsewhere and just as objectionable as many of the better known kinds. My

object then is twofold: first, to increase our purely scientific knowledge of the Australian parasitic fauna, and especially of the "worms"; and secondly, to attack in some measure the scientific and economic problems associated with the existence and eradication of these "pests."

As a result of the courtesy and foresight of the ex-Minister of Agriculture and the chief officer in the Stock branch of the Department of Agriculture of Victoria, a large number of circulars have been printed and distributed to those most likely to assist, especially in this State, inviting their co-operation in sending specimens. As yet, it is too soon to receive much response in the way of material, but considerable interest has been shown in the matter in other States as well as this.

At the outset I wish to thank most sincerely all those who have already helped forward this work—especially the ex-Minister for Agriculture (Hon. George Swinburne, M.L.A.), and the chief veterinary officer in the Stock Branch (Mr. S. S. Cameron, M.R.C.V.S.), Professor Baldwin Spencer, C.M.G., F.R.S., and Dr. T. S Hall, of the Biological Department in this University, and also the librarians and assistants of the several Government and other libraries, who have done their utmost to assist me in my tedious search for records. The names of those to whom my thanks are due for specimens appear in connection with the individual records.

Census.

In undertaking this work it was essential that I should know exactly what has been recorded up to date from or in Australia and Tasmania, and New Guinea with its surrounding islands, these being included on account of the existence of Australian marsupials there. As it seemed that this information would be useful for others also, it is being published here. Although primarily concerned with the endo-parasitic worms, it appeared desirable to add to the list such references as I met in my search, dealing with forms belonging to the Arachnida, etc., which have well-marked endoparasitic stages in their life-histories.

It has been my endeavour to make this list of species as complete as possible. With this purpose, I have examined all the Scientific and Agricultural Journals published in Australia, as well as other catalogues and records of papers published elsewhere as set forth in the appended list. Should, however, any genuine record of Australian Entozoa have been omitted, I shall be glad to have my attention called to it, so that it may be included in an appendix. It has not been possible for me to see a few of the papers referred to, as they are not available in Australia—but by far the larger number of references I have seen and checked. In many instances, especially in the Agricultural and weekly journals, there are vague references to "worms" in various animals, but without identification or even adequate description from which to identify their class. These, of course, have had to be ignored. Also, in a number of cases, well-known worms are described for the benefit of the public, but without any definite statement of their occurrence in that State or States. Some few of the less indefinite of these have been included here with an interrogation mark, but the majority of them bear no evidence of their definite occurrence in Australia. It may not be out of place to urge upon those whose professional work brings them into relation with these forms, that even if the form be a well-known one elsewhere, it is necessary that there should be a definite record of its occurrence in any particular region or State, with any features in which it may differ, in structure, habitat, host, etc., from the usual conditions. There is, further, no doubt that many records have been made on general grounds of naked-eye appearance, habitat, host, etc., instead of being based on a detailed scientific determination. Also, it is very desirable that the nomenclature of these forms should be as consistent as possible. The synonymy of these lower groups of Metazoa is in many cases most involved, and it is a matter of great difficulty for one who is not completely conversant with them to get at the true scientific name of very many, especially in the case of the Nematoda, a group which seems to be consistently shunned by the editors of such publications as Bronn's "Thierreich," etc.

List of Publications Examined for Records.

(Except where otherwise stated, all current periodicals were examined to date.)

Agassiz. "Catalogue of Books, etc., in Zoology, Geology, to 1848."
"Australasian," Melbourne (in part).
Australasian Association for Advancement of Science: Reports.
Australian Medical Gazette.
Australian Medical Journal.
British Medical Association, London: Journal (in part).
Field Naturalists' Club of Victoria; "Victorian Naturalist," Melbourne.
International Catalogue of Scientific Literature.
Intercolonial Medical Journal of Australasia.
Intercolonial Medical Congress of Australasia: Transactions.
"Leader," Melbourne: (in part).
Linnean Society of London, Zoology: Index to Journal of Proceedings, etc., 1838-1890.
Linnean Society of New South Wales: Proceedings.
New South Wales, Department of Mines and Agriculture:
  Agricultural Gazette.
  Agricultural Bulletins.
  Miscellaneous Publications.
Philosophical Society of Adelaide: Transactions.
Philosophical Society of New South Wales: Proceedings and Transactions.
Philosophical Society of North Queensland: Proceedings.
Philosophical Society of Queensland: Transactions.
Philosophical Society of Victoria: Transactions.
Quarterly Journal of Microscopical Science: Index 1844 to 1888.
Queensland, Department of Agriculture:
  Agricultural Journal.
  Agricultural Bulletins.
  Agricultural Reports.
Record of Zoological Literature, 1864 to date.
Royal Society of London: Catalogue of Scientific Papers, 1800-1863.

Royal Society of New South Wales: Transactions and Journal and Proceedings.

Royal Society of Queensland: Proceedings.

Royal Society of South Australia: Transactions and Index.

Royal Society of Tasmania: Papers and Proceedings.

Royal Society of Van Diemen's Land (see Tasmania).

Royal Society of Victoria: Transactions and Proceedings.

South Australia, Department of Agriculture: Journal of Agriculture and Industry.

Tasmania, Department of Agriculture: Agricultural Gazette, or Journal of the Council of Agriculture.

Tasmanian Society: Journal of Natural Science, Agriculture, etc.

Victoria, Department of Agriculture:
Agricultural Journal.
Agricultural Bulletins.

Victorian Agricultural and Horticultural Gazette, Geelong.

Victorian Institute for the Advancement of Science: Transactions.

West Australia, Department of Agriculture: Agricultural Journal.

Wombat, The: or Geelong Naturalist.

Zoological Society of London: Proceedings. Index 1830 to 1870.

From this list it will be seen that I have endeavoured to cover the whole period up to date in European and American literature, and in more detail, the Australian publications, any records in which are not likely to be included in such volumes as the Zoological Record.

Species.	Host.	Locality.	Recorder.	Record.
Amphistomum conicum (Zed. et Rud.)	(See Paramphistomum)			
Amphistomum scleroporum, Crepl. 1844	*Reptilia* " Sea-tortoise "	Ralum, Bismarck Ar.	Braun	Centrbl. Bakter., xxv., 1899, p. 725 (1)
Amphistomum, sp. .	*Reptilia* Elseya dentata	Queensland	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 213 (2)
Bilharzia -	(See Schistosomum)			
Distomum amphiorchis, Braun -	*Reptilia* " Sea-tortoise "	Ralum, Bismarck Ar.	Braun	Centrbl. Bakter., xxv., 1899, p. 719 (1)
Distomum anthos, Braun -	" Sea-tortoise "	Ralum, Bismarck Ar.	Braun	Centrbl. Bakter., xxv., 1899, p. 720. (1)
Distomum contortum, Rud. -	*Pisces* Orthagoriscus mola (gills)	PortStephens N.S.W.	Macleay	Proc. Linn. Soc. N.S.W., i., 1875-7, p. 12. (3)
Distomum cymbiforme, Rud. -	*Reptilia* " Sea-tortoise "	Ralum, Bismarck Ar.	Braun	Centrbl. Bakter., xxv., 1899, p. 720. (1)
Distomum gelatinosum, Rud. 1819	" Sea-tortoise "	Ralum, Bismarck Ar.	Braun	Centrbl. Bakter., xxv., 1899, p. 716 (1)
Distomum hepaticum, L. -	*Mammalia* Homo	South Aus.	Crawford	Aus. Med. Jour., ix., 1864, p. 29

Species.	Host.	Locality.	Recorder.	Record.	
Distomum hepaticum, L.	Ovis aries (liver)	Midland, Tas.	Harrop	Papers and Proc. Royal Soc. Tas., 1869, p. 12	
Distomum hepaticum, L.	Ovis aries (liver)	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 822	(4)
Distomum hepaticum, L.	Ovis aries (liver)	N.S.W.	—	Agri. Gaz. N.S.W., iv., 1894, p. 479	
Distomum hepaticum, L.	Ovis aries (liver)	N.S.W.	Stewart	Agri. Gaz. N.S.W., xi., 1900, p. 841	
Distomum hepaticum, L.	Ovis aries (liver)	Victoria	Brown	Agri. Jour. Vic., ii., 1904, p. 1001; iii., 1905, p. 41	
Distomum hepaticum, L. Distomum hepaticum, L.	Ovis aries (liver) Bos taurus (liver)	West Aus., from East. Aus.	Cleland	Jour. of Agri., W.A., xv., 1907, p. 88	
Distomum hepaticum, L.	Macropus major (bile ducts and liver)	N.S.W., Q'ld.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 212	(5)
Distomum hepaticum, L.	Macropus major (bile ducts and liver)	Australia	Bremser	v. Cobbold's "Parasites of Animals," p. 431	
Distomum hepaticum, L.	"Kangaroo liver and bile ducts"	Australia	Rudolphi	Entozoorum Synopsis, 1819, p. 725	
Distomum hepaticum, L. (?)	"Kangaroo liver and bile ducts"	Australia	Bennett	Veterinarian, xlviii., 1875, p. 123	
Distomum hepaticum, L. (?)	Ovis aries (liver)	Australia	—	Veterinarian, xlv., 1872, p. 542	
	Reptilia				
Distomum irroratum, Rud.	"Sea-tortoise"	Ralum, Bismarck Ar.	Braun	Centrbl. Bakter., xxv., 1899, p. 717	(1)

Species.	Host.	Locality.	Recorder.	Record.	
	Mammalia				
Distomum ornithorhynchi, Johnston	Ornithorhynchus anatinus (stomach, duodenum and small intestine)	N.S.W.	Johnston	Proc. Linn. Soc. N.S.W., (ii.), xxvi., 1901, p. 334.	
	Aves				
Distomum porrectum, Braun	Saurophaga saurophaga	Ralum, Bismarck Ar.	Braun	Centrbl. Bakter., xxv., 1899, p. 714	(1)
	Pisces				
Distomum pristiophori, Johnston	Pristiophorus cirratus, Lath. (body cavity)	N.S.W.	Johnston	Proc. Linn. Soc. N.S.W., xxvii., 1902, p. 326	
Distomum sinense	(See Opisthorchis sinensis)				
	Mammalia				
Distomum, sp. (?)	Homo: (Ova in cysts)	Australia (?)	Ralph	Aus. Med. Jour., x., 1865, p. 156	
Distomum, sp. (?)	Bos taurus: (encysted ovum in lung)	Kew, Vic.	Ralph	Aus. Med. Jour., x., 1865, p. 1	
Distomum, sp. (?)	Ovis aries	Vic., N.S.W.	Dowling	Australasian, 1895, i., p. 442.	
Distomum, sp. (?)	?	Victoria	Brown	Agri. Jour. Vic., v., 1907, p. 512, 640.	
	Aves				
Distomum, sp. (?)	Ardea pacifica	N.S.W., Q'ld.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 213	(5)
Distomum, sp. (?)	Herodias alba	N.S.W., Q'ld.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 213	(5)

Species.	Host.	Locality.	Recorder.	Record.	
Distomum, sp. (?)	Porphyrio melanotus	N.S.W., Q'ld.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 213	(5)
	Pisces				
Distomum, sp. (?)	"Large percoid fish"	N.S.W., Q'ld.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 214	(5)
	Intermediate hosts,				
Distomum, sp. (?)	in Bulinus tenuistriatus	Wimmera and S.&W. Vic.	Cherry	Proc. Roy. Soc. Vic., viii., 1895, p. 183	
Distomum, sp. (?)	Bulinus pectorosis Bulinus comcinnus	Victoria	Macpherson	Australasian, 1895, p. 154, and 1896 (Jan.)	
Distomum, sp. (?)	Bulinus tenuistriatus Planorbis sp., Ancylus australicus	Heidelberg, V.	Fielder, O'Neill and Cummins	Vic. Nat. Vic., xii., 1895-6, p. 123	
Distomum, spp. (?)	Also in Ancylus tasmanicus, Segmentina victoriae, Planorbis gilberti, Bulinus gibbosa, var. fusiformis	Heidelberg, V.	Fielder	Vic. Nat. Vic., xii., 1895-6, p. 139	
Distomum, spp. (?)	Bulinus texturata, Limnaea essoni	N.E. Vic.	Fielder	Vic. Nat. Vic., xii., 1895-6, p. 139	
Distomum, spp. (?)	Bulinus aliciae, var. turrita; Potomopyrgus, sp.	Ballarat, Vic.	Fielder	Vic. Nat. Vic., xii., 1895-6, p. 146.	
Distomum, spp. (?)	Amphipeplea papyraceae	Warrn'mbool, Vic.	Fielder	Vic. Nat. Vic., xii., 1895-6, p. 146	
Distomum, spp. (?)	Limnaea brazieri	Port Fairy, V.	Fielder	Vic. Nat. Vic., xii., 1895-6, p. 146	

Species.	Host.	Locality.	Recorder.	Record.
Distomum, spp. (?)	Bulinus newcombi Limnaea brazieri Unio australis	N.S.W.	Fielder	Vic. Nat. Vic., xiii., 1896-7, p. 24
Distomum, spp. (?)	Bulinus brazieri	N.S.W.	Cobb	Agri. Gaz. N.SW., viii., 1897, p. 453, etc.
	Aves			
Hemistomum intermedium, Johnston	Cygnus atratus, Lath. (duodenum)	Duckmaloi R., N.S.W.	Johnston	Proc. Linn. Soc. N.S.W.. xxix., 1904, p. 110 (6)
Hemistomum triangulare, Johnston	Dacelo gigas (duodenum and small intestine)	Jervis Bay, N.S.W.	Johnston	Proc. Linn. Soc. N.S.W., xxix., 1904, p. 108 (6)
	Mammalia			
Holostomum alatum (Distomum alatum, Rud.)	Canis familiaris	N.S.W.	Macleay	Proc. Linn. Soc. N.S.W., x., 1885, p. 343
	Aves			
Holostomum hillii, Johnston	Larus novae-hollandiae (duodenum)	Jervis Bay, N.S.W.	Johnston	Proc. Linn. Soc. N.S.W.. xxix., 1904, p. 111 (6)
Holostomum musculosum, Johnston	Sterna bergii, Licht. (duodenum)	Broken Bay, N.S.W.	Johnston	Proc. Linn. Soc. N.S.W.. xxix., 1904, p. 112 (6)
Holostomum simplex, Johnston	Ardea novae-hollandiae, Lath. (intestine)	Broken Bay, N.S.W.	Johnston	Proc. Linn. Soc. N.S.W.. xxix., 1904, p. 112 (6)
	Reptilia			
Monostomum album, K. et Hass. 1822	" Sea-tortoise "	Ralum, Bismarck Ar.	Braun	Centrbl. Bakter., xxv., 1899, p. 723 (1)
Monostomum reticulare, V. Ben. 1859	" Sea-tortoise "	Ralum, Bismarck Ar.	Braun	Centrbl. Bakter., xxv., 1899, p. 725 (1)

Species.	Host.	Locality.	Recorder.	Record.	
Monostomum rubrum, K. et Hass. 1892	"Sea-tortoise"	Ralum, Bismarck Ar.	Braun	Centrbl. Bakter., xxv., 1899, p. 724	(1)
Monostomum trigonocephalum, (Rud. 1809)	"Sea-tortoise"	Ralum, Bismarck Ar.	Braun	Centrbl. Bakter., xxv., 1899, p. 725	(1)
	Mammalia				
Opisthorchis sinensis (Cobb, 1875)	Homo (from China)	Sydney, N.S.W.	Jamieson	Aus. Med. Gaz., xvi., 1897, p. 71	
Opisthorchis sinensis (Cobb, 1875)	Homo (from China)	Sydney, N.S.W.	Corlette	Aus. Med. Gaz., xvi., 1897, p. 147	
Opisthotrema pulmonale, Linstow	Halicore australis (lung)	Torres Sts.	Linstow	Centrbl. Bakter., xxxvii., 1904, p. 678	
Paramphistomum cervi (Zed., 1790)	Bos taurus (rumen)	Townsville, Q.	Cobb	Agri. Gaz. N.S.W.. ii., 1891, p. 614	(7)
Paramphistomum cervi (Zed., 1790)	Bos taurus (rumen)	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 822	(4)
Paramphistomum cervi (Zed., 1790)	Bos taurus (rumen)	Eastn. Aus.	Cleland	Jour. Agri. W.A., xv., 1907, p. 88, 91	
Paramphistomum cervi (Zed., 1790) (?)	Ovis aries	N.S.W., Q'ld.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 212	(5)
Paramphistomum cervi (Zed., 1790)	Bos taurus	Wangaratta, Vic.	Sweet	Proc. Roy. Soc. Vic., xxi. (2), 1908, p. 505	
Schistosomum haematobium (Bilharz)	Homo	Newcastle, N.S.W.	Newmarch	Aus. Med. Gaz. xxvi., 1907, p. 336	
Schistosomum haematobium (Bilharz)	Homo (from South Africa)	Australia	Stacy	Aus. Med. Gaz., xxv., 1906, p. 397	
Schistosomum haematobium (Bilharz)	—	Australia (?)	Johnson	Trans. Inter. Med. Cong. Aus., 1905, p. 380	

Species.	Host.	Locality.	Recorder.	Record.
Schistosomum, sp.	—	Australia	Johnson	Trans. Inter. Med. Cong. Aus., 1905, p. 380
?	"Wallaby, Hare, and Rabbit"	N.S.W.	Cobb	Agri. Gaz. N.S.W., xv., 1904, p. 659
	Aves			
?	"Egg of Fowl"	Victoria	Spencer	Proc. Roy. Soc. Vic., i., 1888, p. 109
?	"14 birds (gall bladder, etc.")	Queensland	Bancroft	Proc. Roy. Soc. Qld., vi., 1889, p. 61

II.—CESTODES.

Species.	Host.	Locality.	Recorder.	Record.
	Mammalia			
Anoplocephala mammillana, Mehlis	Equus caballus (sm. intes.)	N.S.W.	Cobb	Agri. Gaz. N.S.W., xvi., 1905, p. 630
Anoplocephala perfoliata (Goeze)	Equus caballus (sm. intes.)	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 821
Anoplocephala perfoliata (Goeze)	Equus caballus (caecum and colon)	N.S.W.	Cobb	Agri. Gaz. N.S.W., xvi., 1905, p. 631.
Anoplocephala perfoliata (Goeze)	Equus caballus (intestine)	Victoria (?)	Brown	Agri. Jour. Vic., i., 1902, p. 698
Anoplocephala perfoliata (Goeze)	Equus caballus (intestine)	South Aus.	Desmond	Jour. Agri. and Ind. S.A., ix., 1905-6, p. 248, 252
Anoplocephala perfoliata (Goeze)	Equus caballus (intestine)	Victoria	Sweet	Proc. Roy. Soc. Vic., xxi. (2), 1908, p. 505
Anoplocephala plicata (Rud)	Equus caballus (sm. intes.)	S.E. S. Aus.	Desmond	Jour. Agri. and Ind. S.A., ix., 1905-6, p. 249-252
Anoplocephala plicata (Rud) (?)	Equus caballus (sm. intes.)	N.S.W.	Cobb	Agri. Gaz. N.S.W., xvi., 1905, p. 628

Species.	Host.	Locality.	Recorder.	Record.	
Anoplocephala, sp. (?)	Equus caballus (sm. intes.)	N.S.W.	Cobb	Agri. Gaz. N.S.W., xvi., 1905, p. 629	
	Aves				
Aporina alba, Führmann	Ptilorchis alberti	Australia	Führmann	Zool. Anz. xxv., 1901, p. 357	
Amphiptyches	(See Gyrocotyle)				
	Mammalia				
Bertia edulis, Zsch.	Phalanger ursinus (intes.)	Celebes and North Aus.	Zschokke	Zeitschrift Wissen. Zool., lxv., 1898-9, p. 404, 440 Zool. Anz., xxi., 1898, p. 477	(8)
Bertia obesa, Zsch.	Phascolarctos cinereus	N.E. Aus.	Zschokke	Zeit. Wissen. Zool., lxv., 1898-9, p. 404. Zool. Anz., xxi., 1898, p. 481	(8)
				Denk. Ges. Jena, viii. ; Semon, v., 1898, p. 368	
Bertia rigida, Janicki.	Phalangista, sp.	New Guinea	Janicki	Zeit. Wissen. Zool., lxxxi., 1906, p. 528 Zool. Anz., xxix., 1906, p. 127	
Bertia sarasinorum, Zsch.	Phalanger ursinus	Celebes and North Aus.	Zschokke	Zeit. Wissen, Zool., lxv., 1898-9, p. 404, 440 Zool. Anz. xxi., 1898, p. 477	(8)
	Aves				
Biuterina paradisea, Fuhrmann	Paradisea raggiana	New Guinea	Führmann	Zool. Anz., xxv., 1901, p. 357	
	Reptilia				
Bothridium arcuatum, Baird (?)	Morelia spilotes (intestine)	N.S.W.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 214	(5)
Bothridium arcuatum, Baird	Morelia spilotes (intestine)	N.S.W.	Baird	Proc. Zool. Soc. Lond., 1865, p. 68	

Species.	Host.	Locality.	Recorder.	Record.	
	Mammalia				
Bothriocephalus antarcticus, Baird	"Stomach and Intestine of a Southern Seal"	Australia (?)	Baird	Proc. Zool. Soc. Lond., xxi., 1853, p. 25	
Bothriocephalus decipiens	"Australian cat"	Australia	Cobbold	"Parasites of Animals," p. 308	(9)
Bothriocephalus mansoni, Cobbold	Homo	N.S.W.	Spencer	Trans. Inter. Med. Cong. Aus., 1892, p. 433	
Bothriocephalus mansoni, Cobbold (larvæ)	Homo	Australia	Hill	Trans. Inter. Med. Cong. Aus., 1905, p. 367-8	
Bothriocephalus (?) marginatus, Krefft.	Halmaturus, sp.	Queensland	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 227	(2)
	Pisces				
Bothriocephalus microcephalus, Rud.	Orthagoriscus mola (intestine)	Port Stephens N.S.W.	Macleay	Proc. Linn. Soc. N.S.W., i., 1875-7, p. 12	(3)
	Mammalia				
Cittotaenia zschokkei, Janicki	Macropus, sp.	New Guinea	Janicki	Zeit. Wissen. Zool., lxxxi., 1906, p. 528 Zool. Anz., xxix., 1906, p. 128 Inter. Cat. Sc. Lit., vi., 1906, Verm., p. 29	
Dibothriocephalus felis, Creplin (?)	Felis domestica (sm. intes.)	Sydney	Cobb	Agri. Gaz. N.S.W., xvi., 1905, p. 210	
Dibothriocephalus parvus	"Syrian man"	Launceston, Tas.	Stephens	Annals of Trop. Med. and Parasitology, Feb., 1908	
Dipylidium caninum (L.)	Canis familiaris (intestine)	N.S.W.	Cobb	Agri. Gaz. N.S.W., xvi., 1905, p. 312	
Dipylidium ellipticum, Butsch.	Felis domestica (sm. intes.)	N.S.W.	Cobb	Agri. Gaz. N.S.W., xvi., 1905, p. 210	

Species.	Host.	Locality.	Recorder.	Record.
	Pisces			
Gyrocotyle (Amphiptyches) nigrosetosa, Haswell	Chimaera ogilbyi	N.S.W.	Haswell	Proc. Linn. Soc. N.S.W., xxvii., 1902, p. 48
Gyrocotyle urna (Grube and Wagener)	Callorhynchus antarcticus (mouth)	Australia	Spencer	Trans. Roy. Soc. Vic., i. (part ii.), 1888, p. 138
	Reptilia			
Ichthyotaenia biroi, Rátz	Varanus, sp.	New Guinea	Rátz	C.R. Soc. Biol., vol. 52
Ichthyotaenia saccifera, Rátz	Varanus, sp.	New Guinea	Rátz	C.R. Soc. Biol., vol. 52
	Mammalia			
Linstowia (Taenia) echidnae, D'a. W. Thompson	Echidna hystrix (al. canal)	N.E. Aus.	Thompson	Jour. Roy. Mic. Soc., June, 1893, iii.
			Zschokke	Zool. Anz., xix., 1896, p. 480 (8)
				Zool. Anz., xxi., 1898, p. 478
				Denk. Ges. Jena, viii.; Semon, v., 1898, p. 359
				Zeit. Wissen. Zool., lxv., 1898-9, p. 404
Linstowia semoni, Zschokke	Perameles obesula (alim. canal)	N.E. Aus.	Zschokke	Zool. Anz., xix., 1896, p. 4
				Denk. Ges. Jena, viii.; Semon, v., 1898, p. 359
	Aves			
Moniezia (Taenia) beauforti, Janicki	Cyclopsittacus diopthalmus	New Guinea	Janicki	Inter. Cat. Sc. Lit., vi., 1906; Verm., p. 29
	Mammalia			
Moniezia festiva (Rud.)	Macropus giganteus	Australia	Zschokke	Zeit. Wissen. Zool., lxv., 1898-9, p. 442

Species.	Host.	Locality.	Recorder.	Record.
Moniezia festiva (Rud.)	Macropus giganteus (gall bladder and hepatic ducts) and Halmaturus derbyanus	Australia	Cobbold	"Parasites of Animals," p. 432 (9)
Moniezia festiva (Rud.)	Halmaturus giganteus (intestine)	Australia	Rudolphi	Entozoorum Synopsis, 1819, p. 146
Moniezia festiva (Rud.)	Macropus giganteus	Australia	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 210
	Oligochaeta			
Monocercus didymogastris, Hill	Didymogaster sylvatica, Fletcher (cyst.)	N.S.W.	Hill	Proc. Linn, Soc. N.S.W. (2), ix., 1894, p. 70
	Aves			
Paronia carrinoi, Diamare	Lorius erythrothorax and Cyclopsittacus sudvissimus	New Guinea	Diamare	Centrbl. Bakter., xxviii., 1900, p. 846
	Pisces			
Phyllobothrium vagans, Haswell	Heterodontus phillipii	N.S.W.	Haswell	Quart. Jour. Micr. Sci., xlvi., 1902, p. 399
	Reptilia			
Piestocystis hoplocephali, Hill	Hoplocephalus superbus (cyst in peritoneum around intestine)	N.S.W.	Hill	Proc. Linn. Soc. N.S.W. (2), ix., 1894, p. 49
Piestocystis lialis, Hill	Lialis burtonii, Gray (cyst)	N.S.W.	Hill	Proc. Linn. Soc. N.S.W. (2), ix., 1894, p. 61

Species.	Host.	Locality.	Recorder	Record.	
	Oligochaeta				
Polycercus, sp.	Didymogaster sylvatica, Fletcher (cyst)	N.S.W.	Haswell and Hill	Proc. Linn. Soc. N.S.W. (2), viii., 1893, p. 365	
	Pisces				
Synbothrium, sp.	Sciaena aquila (cyst in peritoneum)	N.S.W.	Hill	Proc. Linn. Soc. N.S.W. (2), ix., 1894, p. 75	
	Aves				
Taenia australis, Krabbe	Dromaeus novae-hollandiae (stomach)	Australia (?)	Krabbe	Vidensk. Selsk., Skr., 5; Raekke, Natur. vg Math., Afd. 8, Bd. vi., Kjobenhavn, 1869, p. 345 (v. Zool. Record, 1869, p. 635)	
Taenia bairdii, Krefft	Anas superciliosa	N.S.W., Q'ld.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 212, 224	(5)
	Mammalia				
Taenia bipapillosa	Phascolomys, sp.	Zool. Gard., Lond.	Leidy	Proc. Ac. Nat. Sc. Phil., xxvii., 1875, p. 14 Cobbold "Parasites of Animals," p. 432	
	Aves				
Taenia chlamydera, Krefft	Chlamydera maculata	N.S.W.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 212, 224	(5)
	Mammalia				
Taenia coenurus	Canis familiaris	S.E. S. Aus.	Feuerheerdt	Jour. of Agri. and Ind. S. Aus., i., 1898, p. 834	
Taenia coenurus	Canis familiaris	Victoria	Brown	Agri. Jour. Vic., i., 1902, p. 614	
Coenurus cerebralis	Ovis aries	Victoria	Brown	Agri. Jour. Vic., i., 1902, p. 614	

Species.	Host.	Locality.	Recorder.	Record.
Coenurus cerebralis	- Ovis aries	Australia	Kendall	Aust. Vet. and Live Stock Jour., i., 1890, p. 193
Coenurus cerebralis (?)	- Ovis aries	South Aus.	Dixon	Trans. Roy. Soc. S. Aus., vi., 1882-3, p. 178
	Aves			
Taenia coronata, Krefft	- Himantopus leucocephalus	N.S.W., Q'ld.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 213, 220 (5)
	Mammalia			
Taenia crassicollis	- Felis domesticus (intestine)	Victoria (?)	Brown	Agri. Jour. Vic., i., 1902, p. 698
Taenia crassicollis	- Felis domesticus (intestine)	Sydney	Cobb	Agri. Gaz. N.S.W., xvi., 1905, p. 210
Taenia crassicollis	- Felis domesticus (intestine)	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 821
Cysticercus fasciolaris	- Mus decumanus (?)	Australia	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 206
Cysticercus fasciolaris	- Mus musculus and Mus decumanus (?) (liver)	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 821
Taenia cucumerina	- Canis familiaris	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 821
Taenia cucumerina	- Canis familiaris	Victoria (?)	Brown	Jour. Agri. Vic., i., 1902, p. 614
	Aves			
Taenia cylindrica Krefft.	- Anas superciliosa	N S.W.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 212, 220 (5)
	Mammalia			
Taenia denticulata	- Bos taurus	West Aus.	Cleland	Jour. Agri. W.A., xv., 1907, p. 88

Species.	Host.	Locality.	Recorder.	Record.
Taenia echinococcus, von Sieb. -	Canis familiaris	South Aus.	Davies-Thomas	Trans. Roy. Soc. S. Aus., v., 1881-2, p. 120
Taenia echinococcus, von Sieb. -	(?)	Australia	von Lendenfeld	Zool. J.B., ii., p. 409-410
Taenia echinococcus, von Sieb. -	Canis familiaris	N.S.W.	Cobb	Agri. Gaz. N.S.W., xvi., 1905, p. 619
Taenia echinococcus, von Sieb. -	Canis familiaris	South Aus.	Thomas	Agri. Gaz. N.S.W., xvi., 1905, p. 624
Echinococcus polymorphus -	Homo (liver)	Australia	Motherwell	Aus. Med. Jour., vii., 1862, p. 40
Echinococcus polymorphus -	Homo (liver)	Australia	Robertson	Aus. Med. Jour., vii., 1862, p. 48
Echinococcus polymorphus -	Homo (uterus)	Australia	Richardson	Aus. Med. Jour., vii., 1862, p. 9
Echinococcus polymorphus -	Homo (uterus)	Australia	Tracy	Aus. Med. Jour., vii., 1862, p. 58
Echinococcus polymorphus -	Homo (cheek)	Australia	Gilbee	Aus. Med. Jour., vii., 1862, p. 273
Echinococcus polymorphus -	Homo (kidney)	Australia	Cooper	Aus. Med. Jour., viii., 1863, p. 122
Echinococcus polymorphus -	Homo (lung)	Australia	Dunn	Aus. Med. Jour., viii., 1863, p. 23
Echinococcus polymorphus -	Homo (lung)	Victoria	Dowling	Aus. Med. Jour., ix., 1864, p. 105
Echinococcus polymorphus	Homo (brain)	N.S.W.	—	Aus. Med. Jour., ix., 1864, p. 316
Echinococcus polymorphus -	Homo (thigh)	N.S.W.	—	Aus. Med. Jour., ix., 1864, p. 46

Species.	Host.	Locality.	Recorder.	Record.
Echinococcus polymorphus	Homo (brain)	Australia	Atkinson	Aus. Med. Jour., xii., 1867, p. 290
Echinococcus polymorphus	Homo	South Aus.	Davies-Thomas	Trans. Roy. Soc. S. Aus., iv., 1880-1, p. 161
Echinococcus polymorphus	Homo	South Aus.	Davies-Thomas	Trans. Roy. Soc. S. Aus., vi., 1883, p. 11, 22
Echinococcus polymorphus	Homo	Victoria	Davies-Thomas	Trans. Roy. Soc. S. Aus., vi., 1883, p. 9
Echinococcus polymorphus	Homo	Tasmania	Davies-Thomas	Trans. Roy. Soc. S. Aus., vi., 1883, p. 13
Echinococcus polymorphus	Homo	Queensland	Davies-Thomas	Trans. Roy. Soc. S. Aus., vi., 1883, p. 12
Echinococcus polymorphus	Homo	N.S.W.	Davies-Thomas	Trans. Roy. Soc. S. Aus., vi., 1883, p. 14
Echinococcus polymorphus	Homo (brain)	Australia	Hawkins	Aus. Med. Gaz., 1882, p. 1
Echinococcus polymorphus	Homo (brain)	Australia	Verco	Trans. Inter. Med. Cong. Aus., 1887, p. 81
Echinococcus polymorphus	Homo (brain)	Australia	Davies-Thomas	Trans. Inter. Med. Cong. Aus., 1887, p. 61
Echinococcus polymorphus	Homo (brain)	Australia	Davies-Thomas	Trans. Inter. Med. Cong. Aus., 1889, p. 329
Echinococcus polymorphus	Homo (brain)	Australia	Davies-Thomas	Trans. Inter. Med. Cong. Aus., 1892, p. 378
Echinococcus polymorphus	Homo	Australia	Wills	Agri. Jour. Qld. ii., 1898, p. 490
Echinococcus polymorphus	Homo	Australia	Johnson	Trans. Inter. Med. Cong. Aus., 1905, p. 380[1]

1 Numerous other similar references are to be found in succeeding years of the Medical Journals.

Species.	Host.	Locality.	Recorder.	Record.
Echinococcus polymorphus	- Homo: "and lower animals"	Victoria	Brown	Agri. Jour. Vic., i., 1902, p. 405
Echinococcus polymorphus	- Ovis aries (liver and lungs)	N.S.W.	Mackellar	Proc. Linn. Soc. N.S.W., viii., 1883, p. 280
Echinococcus polymorphus	- Ovis aries (lung)	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 821
Echinococcus polymorphus	- Canis familiaris (lung)	N.S.W.	Perrie	
Echinococcus polymorphus	- Ovis aries Bos taurus Sus scrofa	West Aus.	Cleland	Jour. Agri. W.A., xv., 1907, p. 87
			Clutterbuck	Jour. Agri. W.A., xv., 1907, p. 236
Echinococcus polymorphus	- Oryctolagus cuniculus and Equus caballus	Victoria	Sweet	Proc. Roy. Soc. Vic., xxi. (2), 1908, p. 506
Echinococcus polymorphus	- Macropus major (thorax)	Cologne (Zoo) (?) infected in Aus. or Cologne	Pagenstecker	Vehr. Ver. Heidelb., v., 1870, p. 181-6 Ann. N.H. (4), viii., p. 295
Echinococcus polymorphus	- Halmaturus dorsalis (lungs)	Deception Bay, Q'ld.	Bancroft	Proc. Roy. Soc. Qld., vii., 1890, p. 31
Echinococcus polymorphus	- Halmaturus dorsalis (lungs)	Q. or N.S.W.	Cobb	Agr. Gaz. N.S.W., xvi., 1905, p. 624
Taenia elliptica	- Felis domestica	N.S.W.	Perrie	Agri. Gaz., iii., 1892, p: 821
Taenia expansa	- Ovis aries (intestine)	Trafalgar R., N.S.W.	Cobbold	"Parasites of Animals," p. 346-7
Taenia expansa	- Ovis aries (intestine)	Victoria	Kendall	Aust. Vet. and Live Stock Jour., i., 1890, p. 193
Taenia expansa	- Ovis aries (intestine)	N.S.W.	Bruce	Agri. Gaz. N.S.W., iii., 1892, p. 308

Species.	Host.	Locality.	Recorder.	Record.	
Taenia expansa	Ovis aries (intestine)	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 821	
Taenia expansa	Ovis aries (intestine)	N.S.W.	Stewart	Agri. Gaz. N.S.W., xi., 1900, p. 837	
Taenia expansa	Ovis aries (intestine)	Victoria	Brown	Agri. Jour. Vic., i., 1902, p. 522	
Taenia expansa	Ovis aries (intestine)	Lefroy, Tas.	Willmot	Agri. Gaz. Tas., ix., 1902, p. 222	
Taenia expansa	Ovis aries (intestine)	Swan Bay, Tas.	Willmot	Agri. Gaz. Tas., xii., 1904, p. 64	
Taenia fimbriata, Krefft	Halmaturus (?), sp.	Queensland	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 212, 218	(2)
	Aves				
Taenia flavescens, Krefft	Anas superciliosa. Spatula rhynchotis	Q. or N.S.W.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 212	(5)
Taenia forsteri, Krefft	(see Tetrabothrius forsteri)				
	Mammalia				
Taenia geophiloides, Cobbold	Phascolarctos cinereus	Australia	Cobbold	"Parasites of Animals," p. 432	(9)
Taenia goezii	—	prob. Aus.	Baird	Proc. Zool. Soc. Lond., xxi., 1853, p. 24	
Taenia goezii		prob. Aus.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 206	
	Aves				
Taenia infundibuliformis	Gallus domesticus (intestine)	Victoria (?)	Brown	Agri. Jour. Vic., i., 1902, p. 698	

Species.	Host.	Locality.	Recorder.	Record.	
	Mammalia				
Taenia lata	Ovis aries	N.S.W.	Bruce	Report Austn. Stock Confce., Vic., 1890, p. 84	
Taenia malleus	—	Australia	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 206	
Taenia marginata	Canis familiaris (stomach)	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 821	
Taenia marginata	Canis familiaris (sm. intes.)	N.S.W.	Cobb	Agri. Gaz. N.S.W., xvi., 1905, p. 316	
Taenia marginata	Canis familiaris	Victoria	Brown	Agri. Jour. Vic., i., 1902, p. 614	
Cysticercus tenuicollis	Bos taurus, Ovis aries, Sus scrofa (liver, etc.)	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 821	
Cysticercus tenuicollis	Ovis aries (liver, lungs and heart)	West Aus.	Clutterbuck	Jour. Agri. W.A., xv., 1907, p. 204, 236.	
Cysticercus tenuicollis	Ovis aries, Sus scrofa (liver, lungs and heart)	West Aus.	Cleland	Jour. Agri. W.A., xv., 1907, p. 87	
Taenia mastersii, Krefft	Halmaturus (?), sp.	Queensland	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 212, 221	(2)
Taenia mediocanellata	Homo	Adelaide	Johnson	Trans. Inter. Med. Congress Aus., 1905, p. 380	
	Aves				
Taenia moschata, Krefft	Biziura lobata	N.S.W.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 213, 223	(5)
	Reptilia				
Taenia mychocephala, Rátz	Varanus, sp.	New Guinea	Rátz	C.R. Soc. Biol., lii.	

Species.	Host.	Locality.	Recorder.	Record.		
	Aves					
Taenia novae-hollandiae, Krefft -	Podiceps australis	N.S.W., Q'ld.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 213, 216	(5)	
	Mammalia					
Taenia ovilla, Rivolta -	Ovis aries	West Aus.	Cleland	Jour. Agri. W.A., xv., 1907, p. 88		
Taenia ovilla, Rivolta (?) -	Ovis aries	Goulburn, N.S.W.	Cobb	Agri. Gaz. N.S.W., xiii., 1902, p. 796.		
	Aves					
Taenia paradoxa, Krefft -	Podiceps australis	N.S.W., Q'ld.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 213, 217	(5)	
Taenia pediformis, Krefft -	Anas superciliosa Anas punctata	N.S.W., Q'ld.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 213, 222	(5)	
Taenia phalangista, Krefft -	Phalangista vulpina (alim. canal)	N.S.W., Q'ld.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 213, 222	(5)	
	Mammalia					
Taenia phoptica, Cobbold -	Echidna hystrix	Australia	Cobbold	"Parasites of Animals," p. 433	(9)	
	Aves					
Taenia proglottina -	Gallus domesticus (intes.)	Victoria (?)	Brown	Agri. Jour. Vic., i., 1902, p. 698		
Taenia rugosa, Krefft -	Himantopus leucocephalus	N.S.W.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 213, 223	(5)	A
	Mammalia					
Taenia serialis, Bailet (?) -	Canis familiaris	N.S.W.	Cobb	Agri. Gaz. N.S.W., xvi., 1905, p. 318		
Coenurus serialis Baillet (?) -	Oryctolagus cuniculus	Victoria (?)	Sweet	Proc. Roy. Soc. Vic., xxi. (2), 1908, p. 507		

Species.	Host.	Locality.	Recorder.	Record.	
Taenia serrata, Goeze	- Oryctolagus cuniculus (intestine)	N.S.W.	Cobb	Agri. Gaz. N.S.W., xvi., 1905, p. 314	
Cysticercus pisiformis	- Oryctolagus cuniculus and Lepus timidus	Victoria	Brown	Agri. Jour. Vic. i., 1902, p. 614	
Cysticercus pisiformis	- Oryctolagus cuniculus and Lepus timidus	Victoria	Sweet	Proc. Roy. Soc. Vic., xxi. (2), 1908, p. 506	
	Aves				
Taenia sulciceps, Baird	- Diomedea exulans (intes.)	Australia (?)	Baird	Proc. Zool. Soc. Lond., xxvii., 1859, p. 111	
			Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 211	
Taenia tuberculata, Krefft	- Nyroca australis	N.S.W., Q'ld.	Krefft	Trans. Ento. Soc N.S.W., ii., 1871, p. 215	(5)
Taenia zederi, Baird	- "Stomach of Penguin"	Antarctic Oc.	Baird	Proc. Zool. Soc. Lond., 1853, p. 24	B
			Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 211	
	Mammalia				
Taenia, sp.	- Canis familiaris	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 821	
Taenia, sp.	- Equus caballus	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 821	
Taenia, spp.	- Bos taurus	Queensland	Pound	Agri. Dept. Q'land. Rept., 1899, p. 97	
Echinococcus, spp.	- Bos taurus	Queensland	Pound	Agri. Dept. Q'land. Rept., 1899, p. 97	

Species.	Host.	Locality.	Recorder.	Record.
	Aves			
Cysticercus, spp.	Gallus domesticus	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 821
	Pisces			
Cysticercus, spp.	Orthagoriscus mola (intes.)	Port Stephens N.S.W.	Macleay	Proc. Linn. Soc. N.S.W., i., 1875-7, p. 12 (3)
	Mammalia			
Tetrabothrius forsteri (Krefft)	Delphinus forsteri	Port Jackson N.S.W.	Führmann	Centrbl. Bakter xxxv., 1904, p. 745
Tetrabothrius triangulare	—	Port Jackson N.S.W.	Führmann	Centrbl. Bakter., xxxv., 1904, p. 745
	Pisces			
Tetrabothrius reptans (Rud.)	Orthagoriscus mola (muscles and viscera)	Port Stephens N.S.W.	Macleay	Proc. Linn. Soc. N.S.W., i., 1875, p. 12 (3)
	Mammalia			
Triplotaenia mirabilis, Boas	Petrogale penicillata (?) (alim. canal)	Australia	Janicki	Zeit. Wissen. Zool., lxxxi., 1906, p. 520 Zool. Ang. xxvii., 1903-4, p. 243
Triplotaenia mirabilis, Boas	Petrogale penicillata (?) (alim. canal)	Australia	Boas	Zool. Jahrb. Syst., xvii., p. 329
?	Felis domestica	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 821
	Aves			
?	Gallus domesticus	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 821
?	Nycticorax caledonicus	Victoria (?)	Nicholls	Vic. Nat. Vic., xxi., 1904-5, p. 147

Species.	Host.	Locality.	Recorder.	Record.	
? -	"Muscles, Peritoneal Cavity, etc., in 14 Birds"	Queensland	Bancroft	Proc. Roy. Soc. Qland, vi., 1889, p. 61	
	Reptilia				
? -	Hoplocephalus curtus (intes.)	Victoria (?)	Kitson	Vic. Nat. Vic., xxi., 1904-5, p. 147	
	Amphibia				
? -	Hyla aurea (subcutaneous lymph spaces)	N.S.W.	Haswell	Proc. Linn. Soc. N.S.W. (ii.), v., 1890, p. 661	
	III.—NEMATODES.				
	Pisces				
Amblyonema terdentatum, v. Linstow	Ceratodus forsteri, Krefft (alim. canal)	N.E. Aus.	von Linstow	Denk. Ges. Jena, viii., 1898; Semon, v., p. 470	(8)
Anchylostomum -	(see Uncinaria)				
	Aves				
Ancyracanthus opthalmicus, v. Linstow	Carpophaga brenchleyi (Gray), (eye cavity)	Ralum, Bismark Arc.	von Linstow	Arch. Naturg., lxiii., 1897, p. 286	(1) C
Ascaris australis, v. Linstow -	Baza bismarcki, Sharpe Ninox odiosa, Sil. (al. canal)	Ralum, Bismarck Ar.	von Linstow	Arch. Naturg., lxiii., 1897, p. 282	(1)
	Mammalia				
Ascaris canis, Werner -	Felis domestica	N. S.W. or Q'ld.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 212	(5)
Ascaris canis, Werner -	Felis domestica	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 821	
Ascaris canis, Werner -	Felis domestica (intestine)	N.S.W.	Cobb	Agri. Gaz. N.S.W., xvi., 1905, p. 216	

Species.	Host.	Locality.	Recorder.	Record.	
Ascaris canis, Werner -	Canis familiaris Felis domestica	Victoria (?)	Sweet	Proc. Roy. Soc. Vic., xxi. (2), 1908, p. 515	
Ascaris eperlani (?) -	Dasypus hallucatus	N.E. Aus.	von Linstow	Denk. Ges. Jena. viii., 1898; Semon, v., p. 471	(8)
Ascaris lumbricoides -	Sus scrofa	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 821	(4)
Ascaris lumbricoides -	Sus scrofa	West Aus	Cleland	Jour. Agri. W.A., xv., 1907, p. 88	
Ascaris lumbricoides -	Homo	Victoria	Sweet	Proc. Roy. Soc. Vic., 1909, p.	
Ascaris marginata -	Canis familiaris (stomach)	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892 p. 821	(4)
			Cobb	Agri. Gaz. N.S.W., xvi., 1905, p. 316	
	Pisces				
Ascaris marina (immature) -	Thyrsites atun (peritoneum)	Victoria	Sweet	Proc. Roy. Soc. Vic., xxi. (2), 1908, p. 516	
	Mammalia				
Ascaris megalocephala, Cloquet -	Equus caballus (stomach, duodenum, caecum)	S.E. S. Aus.	Desmond	Jour. Agri. and Ind. S.A., vii., 1903-4, p. 570; ix., 1905-6, p. 252	
Ascaris megalocephala, Cloquet -	Equus caballus (sm. intes.)	Victoria (?)	Brown	Australasian, 1897, ii., p. 224	
Ascaris megalocephala, Cloquet -	Equus caballus	Ralum, Bismarck Ar.	von Linstow	Arch. Naturg., lxiii., 1897, p. 282	(1) C
Ascaris megalocephala, Cloquet -	Equus caballus	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 821	
Ascaris megalocephala, Cloquet -	Equus caballus	Victoria	Sweet	Proc. Roy. Soc. Vic., xxi. (2), 1908, p. 514	
Ascaris mystax -	(see Ascaris Canis)				

Species.		Locality.	Recorder.	Record.		
	Reptilia					
Ascaris papillifera, v. Linstow	"Alim. canal of snake"	Ralum, Bismarck Ar.	von Linstow	Arch. Naturg., lxiii., 1897, p. 281	(1)	
	Mammalia					
Ascaris similis, Baird	"Stomach of a Seal"	Antarctic Seas	Baird	Proc. Zool. Soc. Lond., xxi., 1853, p. 18-25		B
			Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 211		
Ascaris suilla	(see Ascaris lumbricoides)					
Ascaris, sp.	Delphinus forsteri	Australian Waters	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p 212	(5)	
Ascaris, sp.	Ovis aries	N.S.W., Q'ld.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p 212	(5)	
Ascaris, sp.	Perameles nasuta	N.S.W., Q'ld.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p 212	(5)	
	Aves					
Ascaris (?), sp.	Nycticorax caledonicus, Gmelin	Ralum, Bismarck Ar.	von Linstow	Arch. Naturg., lxiii., 1897, p. 282	(1)	C
Ascaris, sp.	Gallus domesticus	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 821	(4)	
Ascaris, sp.	Plotus novae-hollandiae	N.S.W., Q'ld.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 213	(5)	
Ascaris, sp.	Anthochoera carunculata	N.S.W., Q'ld.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 213	(2)	
Ascaris, sp.	Columba livia	N.S.W., Q'ld.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 212	(5)	
	Reptilia					
Ascaris, sp.	Elseya dentata	Queensland	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 213	(2)	

Species.	Host.	Locality.	Recorder.	Record.
Ascaris, sp.	Hinulia whitei	N.S.W.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 214 (5)
Ascaris, sp.	Phyllurus milinsii	N.S.W.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 214 (5)
Ascaris, sp.	Morelia spilotes Morelia variegata	N.S.W.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 214 (5)
	Pisces			
Ascaris, sp.	Ceratodus forsteri	Queensland	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 214 (2)
	Mammalia			
Cloacina dahli, v. Linstow	Macropus browni, Rams. (Oes., stom., and large intestine)	Ralum, Bismarck Ar.	von Linstow	Arch. Naturg., lxiii., 1897, p. 286 (1)
Cylichnostomum calicatum	Equus caballus	Horsham, V.	Sweet	Proc. Roy. Soc. Vic., xxi. (2), 1908, p. 513
Cylichnostomum poculatum	Equus caballus	Horsham, V.	Sweet	Proc. Roy. Soc. Vic., xxi. (2), 1908, p. 511
Cylichnostomum tetracanthum	Equus caballus	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 821
Cylichnostomum, spp.	Equus caballus	Horsham, V.	Sweet	Proc. Roy. Soc. Vic., xxi. (2), 1908, p. 511, 512
Dochmius hypostomus	Equus caballus (tumours in stomach)	Port Pirie, Hawker, Yorke's Pn., S. Aus.	Desmond	Jour. Agri. and Ind. S.A., vii., 1904, p. 569

Species.	Host.	Locality.	Recorder.	Record.
Dochmius hypostomus	- Ovis aries (lumen of intes.)	Trafalgar R., N.S.W.	Cobbold	"Parasites of Animals," p. 346-7
Dochmius hypostomus	- Ovis aries (lumen of intes.)	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 822
Dochmius dentatum	- Sus scrofa	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 822
Dracunculus oculi	- (see Filaria loa)			
Eustrongylus gigas	- Equus caballus (kidneys)	Darling, Vic.	Brown	Australasian, 1896, ii., p. 1262 (10)
Filaria australis, Linstow	- Petrogale penicillata, Gray (body cavity)	Australia	von Linstow	Arch. fur. mikr. Anat., xlix., 1897, p. 610
Filaria bancrofti, Cobb	- Homo	Brisbane	Bancroft	Trans. Inter. Med. Cong. Aus., 1889, p. 51
				Aus. Med. Jour., ns., iv., 1882, p. 361
				Aus. Med. Gaz., xii., 1893, p. 258
Filaria bancrofti, Cobb	- Homo	Queensland	Flynn	Aus. Med. Gaz. xxii., 1903, p. 248
Filaria bancrofti, Cobb	- Homo	Queensland	Colledge	Proc. Roy. Soc. Qld. xv., 1900, p. 127
Filaria bancrofti, Cobb	- Homo	Adelaide	Johnson	Trans. Inter. Med. Cong. Aust., 1905, p. 380
Filaria bancrofti, Cobb	- Metamorphosis in Culex ciliaris, Linn.	Brisbane	Bancroft	Jour. and Proc. Roy. Soc. N.S.W., xxxiii., 1899, p. 48
	Culex fatigans	Brisbane	Bancroft	Aus. Med. Gaz., xxii., 1903, p. 251

Species.	Host.	Locality.	Recorder.	Record.
	Pisces			
Filaria (?) bicolor (Spiroptera (?) bicolor), v. Linst w	Galaxias attenuatus	South Aus.	von Linstow	Mt. Mus. Berlin, i., Heft. 2, p. 17
	Mammalia			
Filaria bronchialis	Bos taurus (young), (lungs)	Victoria	Brown and McKenzie	Agri. Jour. Vic., i., 1902, p. 339
Filaria bronchialis	Ovis aries (lungs)	N.S.W.	Bruce	Rept. Aust. Stock Confce. Vic., 1890, p. 84 Agri. Gaz. N.S.W., iii., 1892, p. 308
Filaria demarquayi	Homo (blood)	New Guinea	Manson	"Tropical Diseases," London, 1898, p. 446, etc.
Filaria dentifera, v. Linstow	Phalangista vulpecula, var. typicus	N.E. Aus.	von Linstow	Denk. Ges. Jena, viii., 1898; Semon, v., p. 469 (8)
Filaria hepatica, v. Linstow	Pteropus neohibernicus Prtrs. (bile ducts)	Ralum, Bismarck Ar.	von Linstow	Arch. fur Naturg., lxiii., 1897, p. 282 (1) C
Filaria immitis, Leidy	Intermediate host in Culex skusii (Giles) = Culex fatigans, Wied.	Queensland	Bancroft	Jour. and Proc. Roy. Soc. N.S.W., xxxv., 1901, p. 141; and xxxvii., 1903, p. 254 Aus. Med. Gaz., xxii., 1903, p. 251
Filaria immitis, Leidy	Intermediate host in Anopheles maculipennis	Queensland	Bancroft	Jour. Proc. Roy. Soc. N.S.W., xxxv., 1901, p. 41
Filaria loa	Equus caballus (eye)	Victoria (?)	Brown	Australasian, 1896, ii., p. 1262 (10)
Filaria medinensis	Homo (?)	Melb., from Bombay	Macgillivray	Aus. Med. Jour., v., 1860, p. 172

Species.	Host.	Locality.	Recorder.	Record.	
Filaria medinensis (embryos) -	Homo (?)	Australia (?)	Johnson	Trans. Inter. Med. Cong. Aus., 1905, p. 380	
Filaria nocturna -	(see Filaria bancrofti)				
Filaria osleri -	Canis familiaris (lungs)	Melbourne	McLaughlin	Australasian, 1897, i., p. 855	
Filaria roemeri, v. Linstow -	Macropus antilopinus	Australia	von Linstow	Arch. Mikr. Anat., lxvi., p. 356	
	Pisces				
Filaria sanguinea -	Galaxias scriba (stomach)	Australia	Baird	Proc. Zool. Soc. Lond., 1861, p. 207	
	Mammalia				
Filaria spelaea, Leidy -	"Wallaby (abdominal cavity)"	Australia	Leidy	Proc. Ac. Nat. Sc. Phil., xxvii., 1875, p. 17	(11)
			Cobbold	"Parasites of Animals," p. 433	
	Aves				
Filaria tricuspis, Fedtsch -	Cisticola exilis, Vig Horsf. Graucalus sclateri, Finsch. Calornis metallica, Tecma.	Ralum, Bismarck Ar.	von Linstow	Arch. fur Naturg., lxiii., 1897 p. 282	(1) C
	Mammalia				
Filaria websteri, Cobbold -	Macropus giganteus (knee—joint)	Australia	Cobbold	"Parasites of Animals," p. 433	(12) D
Filaria websteri, Cobbold -	Macropus major (cysts in knee joint)	N.S.W.	Fletcher	Proc. Linn. Soc. N.S.W. (s. 1), viii., 1883, p. 388	
Filaria, sp. -	Homo (?)	Adelaide	Johnson	Trans. Inter. Med. Cong. Aus., 1905, p. 380	
Filaria, sp. -	Halmaturus bennetti (Pericardium)	—	Eisig	Zeit. Wissen. Zool., xx., 1870, p. 99	

Species.	Host.	Locality.	Recorder.	Record.	
Filaria, sp.	"Knee-joint of Kangaroo"	—	Crisp	Proc. Zool. Soc., xxi., 1853, p. 68	D
Filaria (?), sp.	Macropus major	—	Bancroft	Inter. Med. Cong. Aus., 1889, p. 50	
	Aves				
Filaria, spp.	"in blood, peritonal cavity, muscles of thigh, and pericardium of 14 birds especially, Eurystomus pacificus, Gymnorrhina tibiceu, Cracticus torquatus, Trichoglossus novae-hollandiae"	Queensland	Bancroft	Proc. Roy. Soc. Qld., vi., 1889, p. 58	
Filaria, sp.	Centropus ateralbus, Less. (body cavity)	Herbertshöhe, Bismarck Arch.	von Linstow	Arch. Naturg., lxiii., 1897, p. 286	(1) C
Filaria, sp.	Ninox odiosa, Scl.	Ralum, Bismarck Ar.	von Linstow	Arch. Naturg., lxiii., 1897, p. 286	(1) C
	Pisces				
Filaria, sp.	"Imported salt herrings"	N.S.W.	Brazier	Proc. Linn. Soc. N.S.W., v., 1880, p. 629	
Filaria, sp		N. Caledonia	—	Arch. Parasit., vii., p. 377	
	Mammalia				
Gongylonema scutatum	Bos taurus	Victoria	Sweet	Proc. Roy. Soc. Vic., xxi. (2), 1908, p. 523	

Species.	Host.	Locality.	Recorder.	Record.
Haemonchus contortus	Ovis aries (stomach)	N.S.W.	Bruce	Rept. Aus. Stock Conf. Vic., 1890, p. 84 Agri. Gaz. N.S.W., iii., 1892, p. 308
Haemonchus contortus	Ovis aries (stomach)	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 821
Haemonchus contortus	Ovis aries (stomach)	Trafalgar Bay N.S.W.	Cobbold	"Parasites of Animals," p. 346-7
Haemonchus contortus	Ovis aries (4th stomach) Bos taurus	Blackwater, Mackenzie Dist., Q'ld.	Barnes	Report of Dept. of Agri., Queensland, 1897-8, p. 88
Haemonchus contortus	Ovis aries	N.S.W.	Stewart	Agri. Gaz. N.S.W., xi., 1900, p. 837
Haemonchus contortus	Ovis aries (abomasum)	Swan Bay, Tasmania	Willmot	Agri. Gaz. Tas., xii., 1904, p. 64
Haemonchus contortus	Ovis aries	Victoria (?)	Brown	Agri. Jour. Vic., iii., 1905, p. 340
Haemonchus contortus	Ovis aries	Tasmania	Weston	Agri. Gaz. Tas., xv., 1907, p. 218
Haemonchus contortus	Ovis aries	Queensland	Dodd	Agri. Jour. Qld., 1908, Aug., p. 92
	Aves			
Heterakis australis, v Linstow	Macropygia nigrirostris Salvad. (sm. intestine)	Ralum, Bismarck Ar.	von Linstow	Arch. Naturg., lxiii., 1897, p. 286
Heterakis dolichocerca, Stossich	Circus spilothorax	New Guinea	Stossich	Boll. Mus. Genova, 1902, No. 106
Heterakis inflexa	Gallus domesticus (small intestine)	N.S.W.	Cobb	Agri. Gaz. N.S.W., vii., 1896, p. 747; and ix., 1898, p. 316

(1) C

Species.	Host.	Locality.	Recorder.	Record.
Heterakis inflexa -	Gallus domesticus (egg)	N.S.W.	Cobb	Agri. Gaz. N.S.W., xvi., 1905, p. 561
Heterakis papillosa -	Gallus domesticus (caecum)	N.S.W.	Cobb	Agri. Gaz. N.S.W., vii., 1896, p. 748
	Myriapoda			
Heth juli -	Julus, sp. (intestine)	Moss Vale, N.S.W.	Cobb	Agri. Gaz. N.S.W., ix., 1898, p. 299
	Mammalia			
Hoplocephalus cinctus, Linstow (nec Cuvier, 1832) -	Perameles obesula (intes.)	N.E. Aus.	von Linstow	Denk. Ges. Jena, viii.; Semon, v., 1898, p. 469 (8)
Labyrinthostoma, sp., Cobb -	—	N.S.W.	Cobb	Agri. Gaz. N.S.W., ix., 1898, p. 421
	Insecta			
Lepidonema bifurcata, Cobb -	"Insect larvae"	Moss Vale, N.S.W.	Cobb	Agri. Gaz. N.S.W., ix., 1898, p. 315, 453
	Mammalia			
Oesophagostomum columbianum.	Bos taurus, Ovis aries (abomasum and intestine)	Mackenzie & Blackwater Dist., Q'ld.	Barnes	Rept. of Dept. of Agri., Qld., 1897-8, p. 88
Oesophagostomum columbianum (?) -	Bos taurus (intestines)	Queensland (var. parts)	Bancroft	Rept. Dept. Agri. Qld., 1892
Oxyuris curvula -	Equus caballus	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 822
Oxyuris tuberculata -	—	Australia	von Linstow	Arch. Naturg., lxx., 1904, p. 300
			Schneider	Centrbl. Bakter., xxxvi., 1904, p. 550.

Species.	Host.	Locality.	Recorder.	Record.	
Oxyuris vermicularis	- Homo	N.S.W.	Cobb	Jour. Linn. Soc. N.S.W. (ii.), v., 1890, p. 168	
	Aves				
Oxyuris, sp.	- Gallus domesticus	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 822	
	Reptilia				
Physaloptera, sp.	- Diemenia reticulata	N.S.W.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 214	(5)
Physaloptera, sp.	- Cyclodus gigas	N.S.W.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 214	(5)
Physaloptera, sp.	- "Alim. Canal of Snake"	Ralum, Bismarck Ar.	von Linstow	Arch. Naturg., lxiii., 1897, p. 286	(1)
	Mammalia				
Pseudalius inflexus	- Delphinus phocaena (oesophagus and bronchi)	Aus. Seas (?)	von Linstow	Arch. Naturg., xlvi., 1880, p. 49	
Pseudalius minor	- Delphinus phocaena (tympanic cavity), and Delphinus communis (eye)	Aus. Seas (?)	von Linstow	Arch. Naturg., xlvi., 1880, p. 48	
Sclerostomum edentatum	- Equus caballus	Horsham, Vic.	Sweet	Proc. Roy. Soc. Vic., xxi. (2), 1908, p. 507	
Sclerostomum equinum	- Equus caballus	Victoria (?)	Brown	Agri. Jour. Vic., iii., 1905, p. 144	
Sclerostoma pinguicola, Verrill	- Sus scrofa	Australia	Morris and Cobbold	M. Micr. Jour., vi., p. 243-8	

Species.	Host.	Locality.	Recorder.	Record.
Sclerostoma pinguicola, Verrill -	Sus scrofa	Kurrajong, N.S.W.	Musson	Agri. Gaz. N.S.W., xix., 1907, p. 634
Sclerostoma pinguicola, Verrill -	Sus scrofa	N.S.W., Q'ld.	Bancroft	Aus. Med. Gaz., xii., 1893, p. 258
Sclerostomum syngamus -	(see Syngamus trachealis)			
Sclerostomum tetracanthum -	(see Cylichnostomum tetracanthum)			
Sclerostomum vulgare -	Equus caballus	Horsham, V.	Sweet	Proc. Roy. Soc. Vic., xxi. (2), 1908, p. 508
Sclerostomum, sp. -	Equus caballus (stomach)	Sale, Vic.	Weir	Agri. Jour. Vic., ii., 1904, p. 243
	Amphibia			
Spiroptera furcata, v. Linstow -	"Abdominal cavity of Frog"	Ralum, Bismarck Ar.	von Linstow	Arch. Naturg., lxiii., 1897, p. 286 (1)
	Mammalia			
Spiroptera megastoma -	Equus caballus	Kimberley, W.A.	Weir, Le Souef, Edward	Jour. Dept. Agri. W.A., xii., 1905, p. 60
Spiroptera megastoma -	Oryctolagus cuniculus	Darling, Vic.	Brown	Australasian, 1896, ii., p. 1262 Brit. Med. Jour., 1896, ii., p. 1542
Spiroptera megastoma -	Equus caballus (stomach)	Southern South Aus.	Desmond	Jour. Agri. and Ind. S.A., ix., 1905-6, p. 252
Spiroptera megastoma -	Equus caballus (stomach)	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 822
Spiroptera microstoma -	Equus caballus (stomach)	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 822

Species.	Host.	Locality.	Recorder.	Record.	
Spiroptera strongylina	Sus scrofa	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 822	
Spiroptera, sp.	Bos taurus (nodules in muscles)	West Aus.	Cleland	Jour. of Agri. W.A., xv., 1907, p. 88	
Stephanurus dentatus	(see Sclerostoma pinguicola)				
Streptogaster papillatus, Cobb.	(?Parasitic)	N.S.W.	Cobb	Agri. Gaz. N.S.W., ix., 1898, p. 320	
Strongylus apri	Sus scrofa	N.S.W. or Q.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 212	(5)
Strongylus apri	Sus scrofa	N.S.W.	Perrie	Agri. Gaz. N.S.W. iii., 1892, p. 821	
Strongylus apri	Sus scrofa (lungs)	West Aus.	Clutterbuck	Jour. Agri. W.A., xv., 1907, p. 236	
Strongylus armatus (*sic*)	Equus caballus (large intestine)	N.S.W.	Perrie	Agri. Gaz. N.S.W. iii., 1892, p. 821	
Strongylus armatus (*sic*)	Equus caballus (colon and mesenteric artery)	S.E. S. Aus.	Desmond	Jour. Agri. and Ind. S.A., vii., 1904, p. 569	
Strongylus armatus (*sic*)	Equus caballus (blood, intestine muscles and arteries)	Southern South Aus.	Desmond	Jour. Agri. and Ind. S.A., ix., 1905, p. 252	
Strongylus canis bronchialis	(see Filaria osleri)				
Strongylus contortus	(see Haemonchus contortus)				
	Mammalia				
Strongylus filaria	Ovis aries (lungs)	N.S.W., Q'ld.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 212	(5)
Strongylus filaria	Ovis aries (lungs)	Trafalgar R., N.S.W.	Cobbold	"Parasites of Animals," p. 347	

Species.	Host.	Locality.	Recorder.	Record.
Strongylus filaria	Ovis aries (lungs)	Victoria (?)	Brown	Australasian, 1897, i., p. 1168
Strongylus filaria	Ovis aries (lungs)	Australia	Ford	Aus. Med. Jour. iv., 1882, p. 388
				Aus. Med. Jour., v., 1883, p. 153
Strongylus filaria	Ovis aries (lungs)	N.S.W.	Stewart	Agri. Gaz. N.S.W., xi., 1900, p. 839
Strongylus filaria	Ovis aries (lungs)	Victoria (?)	Brown	Agri. Jour. Vic., ii., 1904, p. 72
				Agri. Jour. Vic., iii., 1905, p. 341
Strongylus filaria	Ovis aries (lungs)	Swan Bay, Tasmania	Willmot	Agri. Gaz. Tas., xii., 1904, p. 64
Strongylus filaria	Ovis aries (lungs)	Bishopsbo'rne, Tasmania	Weston	Agri. Gaz. Tas., xv., 1907, p. 217
Strongylus filaria	Ovis aries (lungs)	West Aus.	Cleland	Jour. Agri. W.A., xv., 1907, p. 88
Strongylus filaria	Ovis aries (lungs)	West Aus.	Clutterbuck	Jour. Agri. W.A., xv., 1907, p. 236-7
Strongylus micrurus	Equus caballus	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 821
Strongylus micrurus	Bos taurus (lungs)	West Aus.	Cleland	Jour Agri. W.A., xv., 1907, p. 91
Strongylus micrurus	Bos taurus (lungs)	West Aus.	Clutterbuck	Jour Agri. W.A., xv., 1907, p. 236
Strongylus paradoxus	(see Strongylus apri)			

Species	Host.	Locality.	Recorder.	Record.
	Reptilia			
Strongylus paronai, Stossich	Amphibolurus muricatus	Australia	Stossich	Boll. Mus. Genova, 1902, No. 116
	Mammalia			
Strongylus rufescens	Ovis aries (lungs)	N.S.W.	Stewart	Agri. Gaz. N.S.W., xi., 1900, p. 839
Strongylus rufescens	Ovis aries (lungs)	West Aus.	Cleland	Jour. Agri. W.A., xv., 1907, p. 88
Strongylus rufescens	Ovis aries (lungs)	West Aus.	Clutterbuck	Jour. Agri. W.A., xv., 1907, p. 236
Strongylus rufescens	Ovis aries (lungs)	Bishopsbo'rne, Tasmania	Weston	Agri. Gaz. Tas., xv., 1907, p. 217
Strongylus suis	(see Strongylus apri)			
Strongylus tetracanthum	(see Cylichnostomum tetracanthum)			
	Aves			
Syngamus trachealis	Gallus domesticus	Victoria (?)	Brown	Agri. Jour. Vic., ii., 1904, p. 73, 175
Trichina spiralis	(see Trichinella spiralis)			
	Mammalia			
Trichinella spiralis	Homo	Hobart (from Germany)	—	Aus. Med. Jour., 1870, p. 318
Trichinella spiralis	Homo (?)	Richmond, N.S.W.	—	Aus. Med. Jour., 1871, p. 224
Trichinella spiralis	Homo	Adelaide	Johnson	Aus. Med. Gaz. xxi., 1902, p. 120, 415

Species.	Host.	Locality.	Recorder.	Record.
Trichinella spiralis -	Homo (?)	Adelaide	Johnson	Trans. Inter. Med. Cong. Aus., 1905, p. 370, 380
Trichocephalus affinis -	Ovis aries	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 822
Trichocephalus affinis -	Ovis aries (caecum)	Swan Bay, Tasmania	Willmot	Agri. Gaz. Tas., xii., 1904, p. 64
Trichocephalus crenatus -	Sus scrofa	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 822
Trichocephalus dispar -	Homo (caecum)	N.S.W., Q'ld.	Bancroft	Aus. Med. Gaz., xii., 1893, p. 258
Trichocephalus dispar -	Homo (caecum)	N.S.W., Q'ld.	Mollison	Inter. Med. Jour. Aus., iii., 1898, p. 417
Trichocephalus dispar -	Homo (caecum)	Brisbane	Lawes	Aus. Med. Gaz. xiv., 1895, p. 446
Trichocephalus hepaticus, Bancroft -	Mus rattus (liver)	Brisbane	Bancroft	Jour. and Proc. Roy. Soc. N.S.W., xxvii., 1893, p. 89
	Pisces			
Trichocephalus (?), sp. -	"from large percoid fish"	N.S.W.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 214 (5)
	Mammalia			
Triodontophorus intermedius -	Equus caballus	Horsham, V.	Sweet	Proc. Roy. Soc. Vic., xxi. (2), 1908, p. 509
Uncinaria duodenale -	Homo	Queensland	Hogg	Aus. Med. Gaz., viii., 1888-9, p. 133
				Brit. Med. Jour., 1889, i., p. 792
Uncinaria duodenale -	Homo	Queensland	Gibson and Turner	Trans. Med. Cong. Aust., 1892, p. 134

Species.	Host.	Locality.	Recorder	Record.
Uncinaria duodenale	Homo	Queensland	Bancroft	Aus. Med. Gaz. xii., 1893, p. 258
Uncinaria duodenale	Homo	Brisbane	Lawes	Aus. Med. Gaz., xiv., 1895, p. 445
Uncinaria duodenale	Homo	Cairns, etc., Q'ld., and N. N.S.W.	Turner	Proc. Roy. Soc. Q'land, xi., 1895, p. 99
Uncinaria duodenale	Homo	Queensland	Bancroft	Aus. Med. Gaz. xxi., 1902, p. 66
Uncinaria duodenale	Homo	Queensland	O'Brien	Aus. Med. Gaz., xxvii., 1908, p. 121
Uncinaria trigonocephala	Canis familiaris	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 822
Uncinaria, sp.	Homo	Brisbane	Ashworth	Aus. Med. Gaz., xv., 1896, p. 482
Uncinaria, sp.	Homo	Queensland	Hamilton-Kenny	Aus. Med. Gaz., xxv., 1906, p. 399
	Insecta			
Xyo hystrix, Cobb.	Pasalus, sp. (intestine)	Moss Vale, N.S.W.	Cobb	Agri. Gaz. N.S.W., ix., 1898, p. 315
	Mammalia			
Zoniolaimus setifera, Cobb.	"Stomach of Brush Wallaby"	Moss Vale, N.S.W.	Cobb	Agri. Gaz. N.S.W., ix., 1898, p. 312, 340-1
?	Homo	Brisbane	Ashworth	Aus. Med. Gaz. xv., 1896, p. 482
?	Homo (eye)	Victoria	Tassell	Aus. Med. Jour., xix., 1874, p. 324

Species.	Host.	Locality.	Recorder.	Record.
?	Homo (subcutaneous tissue)	Victoria (from Trop. Africa)	Cherry	Inter. Med. Jour. Aus., iii., 1898, p. 416
?	Homo (excretory organs)	Adelaide	Brummit	Aus. Med. Gaz., xvi., 1897, p. 135
? (larvae)	Bos taurus (nodules in stomach)	West Aus.	Cleland	Jour. Agri. W.A., xv., 1907, p. 88
? ("Worm nests")	Bos taurus	Queensland	Gibson	Inter. Med. Cong. Aus., 1892, p. 576
?	Bos taurus	Queensland	Pound	Dept. Agri. Queensland, Rept. 1898-9, p. 97
?	Equus caballus	Charlton, Vic.	Bull	Agri. Jour. Vic., iii., 1905, p. 580
?	Ovis aries (lungs)	N.S.W.	—	Agri. Jour. Q'land, ii., 1898, p. 420
?	Ovis aries (abomasum)	S.E. of S. Aus.	Williams	Jour. Agri. and Ind. S.A., iv., 1900, p. 159
?	"Kangaroo" (subcutaneous tissue)	Victoria (?)	Kitson	Vic. Nat. Vic., xxi., 1904-5, p. 147
	Aves			
?	"Boobook owl, between skin and skull"	Victoria	Keartland	Vic. Nat. Vic., xxi., 1904-5, p. 147
	Reptilia			
?	Egernia cunninghami	N.S.W.	Krefft	Trans. Ento. Soc. N.S.W., ii., (13) 1871, p. 214
	Pisces			
?	"Fish"	Queensland (?)	Bancroft	Trans. Inter. Med. Cong. Aus., 1889, p. 51

Species.	Host.	Locality.	Recorder.	Record.	
	IV.—NEMATOMORPHA				
Gordius incertus, Villot	—	Tasmania	Villot	Arch. Zool. Exper., iii., p. 181, 39	
Gordius, sp.	—	N.S.W.	Cobb	Agri. Gaz. N.S.W., ii., 1891, p. 213	
	V.—ACANTHOCEPHALA				
Echinorhynchus gigas	—	N.S.W.	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 822	
	Aves				
Echinorhynchus horridus, Linstow	Halcyon sanctus (intestine)	Ralum, Bismarck Ar.	von Linstow	Arch. Naturg., lxiii., 1897, p. 290	
	Mammalia				
Echinorhynchus, sp.	Delphinus forsteri	Aus. Waters	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 212	(5)
	Reptilia				
Echinorhynchus, sp.	Diemenia reticulata	N.S.W.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 214	(5)
	Mammalia				
Gigantorhynchus semoni	Perameles obesula (Geoff.) (alim. canal)	N.E. Aus.	von Linstow	Denk. Ges. Jena, viii., 1898; Semon, v., p. 471	(8)
	VI.—INSECTA				
Gastrophilus equi (larval stage)	Equus caballus	N.S.W. (from New Z'ld.)	Perrie	Agri. Gaz. N.S.W., iii., 1892, p. 822	

Species.	Host.	Locality.	Recorder.	Record.
Gastrophilus equi (larval stage)	Equus caballus	Latrobe, Wynyard, etc., Tasmania	Thompson	Jour. of Council of Agri. Tas., ii., 1894, p. 76
Gastrophilus equi (larval stage) (?)	Equus caballus	Victoria	Brown	Australasian, 1894, i., p. 190
Gastrophilus equi (larval stage)	Equus caballus	Lobethal, Mt. Gambier, etc., S.A.	—	Jour. of Agri. and Ind. S.A. iv., 1901, p. 523, 619, etc. (14)
Gastrophilus equi (larval stage)	Equus caballus	Victoria	French	Agri. Jour. Vic., i., 1902, p. 693
Gastrophilus equi (larval stage)	Equus caballus	Victoria	Brown	Agri. Jour. Vic., ii., 1904, p. 634
Gastrophilus equi (larval stage)	Equus caballus	South Aus.	Desmond	Jour. Agri. and Ind. S.A., ix., 1905-6, p. 252
Gastrophilus haemorrhoidalis (larval stage)	Equus caballus (rectum)	South Aus.	Desmond	Jour. Agri. and Ind. S.A., ix., 1905-6, p. 252
Gastrophilus haemorrhoidalis (larval stage)	Equus caballus (rectum)	Victoria (?)	Brown	Agri. Jour. Vic., ii., 1904, p. 635
Gastrophilus nasalis	Equus caballus	West Aus.	Helms	Jour. Agri. W.A., i., 1899, p. 23
Gastrophilus, sp. (?)	Equus caballus	N.S.W.	Stewart	Agri. Gaz. N.S.W., xi., 1900, p. 841
Gastrophilus, sp. (?)	Equus caballus	N.S.W.	Froggatt	Agri. Gaz. N.S.W., xix., 1908, p. 229
Gastrophilus, sp. (?)	Equus caballus	Mt. Gambier, S.A.	Williams and Weld	Jour. Agri. Ind. S.A., iii., 1900, p. 622
Gastrophilus, sp. (?)	Equus caballus	Victoria	Brown	Agri. Jour. Vic., v., 1907, p. 448

Species.	Host.	Locality.	Recorder.	Record.
Gastrophilus, sp. (?)	Equus caballus	West Aus.	—	Jour. Agri. W.A., x., 1904, p. 43
Gastrophilus, sp. (?)	Equus caballus	West Aus.	Despeissis	Jour. Agri. W.A., xiv., 1906, p. 450
Oestrus ovis (larval stage)	Ovis aries	Tasmania	Morton	Papers and Proc. Roy. Soc. Tas., xxxviii., 1885, p. 258
Oestrus, sp.	Camelus dromedarius	North Aus.	Tepper	Jour. Agri. Ind. S.A., iii., 1900, p. 565
?	Ovis aries	N.S.W.	Stewart	Agri. Gaz. N.S.W., xii., 1901, p. 1542

VI.—ARACHNIDA

Species.	Host.	Locality.	Recorder.	Record.
	Aves			
Acarus depilis, Brown	Gallus domesticus (subcutaneous tissue)	Vic. and S.A.	Brown	Brit. Med. Jour., 1897, ii., p. 1675
Faculifer rostratus	Columbia livia (subcutaneous tissue)	Victoria	Sweet	Proc. Roy. Soc. Vic., xxi., 1908, p. 523 (2)
Linguatula rhinaria	—	Australia (?)	Johnson	Trans. Inter. Med. Cong. Aus., 1905, p. 380
Pentastomum denticulatum	—	Australia (?)	Johnson	Trans. Inter. Med. Cong. Aus., 1905, p. 380
	Reptilia			
Pentastomum teretiusculum, Baird	Hoplocephalus superbus (mouth)	Zool. Gardens, Lond. (from Australia)	Baird Krefft	Proc. Zool. Soc. Lond., 1862, p. 114 Trans. Ento. Soc. N.S.W., ii., 1871, p. 211

Species.	Host.	Locality.	Recorder.	Record.
Pentastomum teretiusculum, Baird	Hoplocephalus superbus (lung) Pseudechys porphyriacus	King Island and Vic.	Spencer	Q.J.M.S. (n.s.), xxxiv., 1892-3, p. 1 (15)
Pentastomum, sp. -	Pseudechys porphyriacus	King Island	Spencer	Proc. Roy. Soc. Vic., i., 1888, p. 110 (16)
Pentastomum, sp. -	Hinulia taeniolata	N.S.W.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 214 (5)
Pentastomum, sp. -	Diemenia reticulata	N.S.W.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 214 (5)
Pentastomum, sp. -	Diplodactylus ornatus	N.S.W.	Krefft	Trans. Ento. Soc. N.S.W., ii., 1871, p. 214 (5)

INDEX TO REFERENCE FIGURES AND LETTERS.

1.	Collected by	Dahl.
2.	,,	Masters.
3.	,,	Brazier.
4.	,,	Perrie.
5.	,,	Krefft and Masters.
6.	,,	Hill.
7.	,,	Jack.
8.	,,	Semon.
9.	,,	Bancroft.
10.	,,	Allen.
11.	,,	Leidy.
12.	,,	Webster and Bancroft.
13.	,,	Krefft.
14.	,,	Drogenmüller.
15.	,,	Spencer and McAlpine.
16.	,,	Spencer.

A. In the collection of the Australian Museum.
B. ,, ,, ,, British Museum.
C. ,, ,, ,, Göttingen Museum.
D. ,, ,, ,, Royal College of Surgeons, London.

ART. XXIII.—*The Endoparasites of Australian Stock and Native Fauna.*

PART II.

New and Unrecorded Species.

BY GEORGINA SWEET, D.Sc., Melb. Univ.

Government Research Scholar.

(With Plate XXIX).

[Read 10th December, 1908.]

In these records, wherever the description of the species is readily obtainable in such books as those by Neumann, Law, etc., it is unnecessary to give detailed descriptions with the record, the latter being quite sufficient; but in cases where the forms are less well known or the descriptions or figures necessary for identification are not easily available here, or where points of variation or special interest are present, these details have been given somewhat more fully than would otherwise have been done, for the convenience of workers in Australia, where much of the literature of this subject is generally unobtainable.

These early records are based largely on a small store of material in the Museum of the Biological Department here: the name (where known) of the collector or donor of each set of specimens accompanies the individual record. The material to hand so far has been preserved in formalin or ordinary alcohol (70 to 90 per cent.). As I have as yet received no living material, I have not been able to try other methods recommended by various workers. Specimens preserved in formalin are, as a rule, very indifferent for histological examination. For examination in bulk, I have tried the following: oil of cloves, carbolised absolute, xylol, pure glycerine, 20 per cent. glycerine, cedar oil and caustic soda: and have found all in a measure

good. Very often, however, the reagent which makes clear one structural detail is useless for some others, so that I always examine each species in several reagents. That most commonly used for Nematodes and most generally satisfactory, especially where time is a consideration, is what I have called carbolised absolute—i.e., a mixture of 80 per cent. of pure carbolic acid and 20 per cent. of absolute alcohol, used also, I believe, by Dr. N. A. Cobb. It is unfortunate that this substance cannot be used for clearing preparatory to mounting in balsam. For purposes of measurement this carbolised absolute is more satisfactory than any other of which I know, except, perhaps, caustic soda and 20 per cent. glycerine, the two former substances retaining the full size and shape of the worm better than any of those mentioned above. In order to determine the reagent best retaining the proportions and full size of the animal, I made a series of experiments with Nematodes, with the following results. Taking the length in carbolised absolute as 100 divisions of a scale, and the width as 4.9 divisions, I found the variations to be as follow:—

Carbolised absolute	100 divisions	×	4.9 divisions.
Caustic soda (50%)	100		4.8
Glycerine (20%)	99		4.9
Absolute alcohol	96-97		4.8
Glycerine (pure)	95		3.7
Oil of cloves	94		4.9
Xylol	93		4
Cedar oil	87		3

(These reagents were not used consecutively on the same worm.)

Since evidently there is less shrinkage and distortion from the use of carbolised absolute than of the other reagents mentioned, I have made all my measurements in this fluid.

The method of description and record can be seen at a glance. In giving the synonymy, it is my purpose to give it in full wherever possible, with the original dates also, though in the early stages of this work it is not always practicable, as there is so much of the literature as yet unobtainable in Australia.

A. Trematodes.

No. 1.—Paramphistomum cervi, Zed., 1790.

= *Festucaria cervi*, Zed., 1790.
= *Monostoma conicum*, Zed., 1803.
= *Amphistomum conicum*, Rud, 1809.
(v. Fischoeder, 1901, p. 368.)

Paramphistomum.—Numerous specimens. Length, 8 to 13 mm.; maximum diameter, 3 to 6 mm.; conical in shape, the mouth being at the apex of the cone. The body is occasionally reddish, otherwise cream in colour. May become easily detached from the wall of the stomach after death of the host, shortening and thickening considerably, often curling up.

Host.—Cow: reticulum and rumen.

Locality.—Wangaratta, Victoria, August, 1908; from Mr. S. S. Cameron, per Dr. Bull.

Previous Records.—From New South Wales and Queensland (v. pt. i., Census).

Remarks.—The opinion of the residents of the locality whence this material came—viz., that it causes considerable mortality in cattle, is in harmony with that of Zurn (Neumann, p. 301) and Cobb (1891, p. 614-5); but I have, as yet, no direct evidence bearing on the point. In this instance the worms were very numerous in the part of the rumen forwarded to me, averaging one to every .5 square millimetres.

B. Cestodes.

No. 1.—Anoplocephala perfoliata, Goeze.

= *Taenia perfoliata*, Goeze.
(v. Bronn's Cestodes, p. 1711.)

Anoplocephala.—21 specimens. Length, 15 to 24 mms.; breadth, 3 to 13 mm.; head, 2 mm. in diameter, tetrahedral and rounded with 4 dome-shaped suckers pointing forwards; prolonged posteriorly into 4 prominent rounded lobes, easily seen from anterior end. Body broad and short. Segments broad and thick, but very short anteriorly, lengthening towards the posterior end; each overlaps the one behind. The curious narrowing of the posterior segments is well seen.

Host.—Horse: ileum and caecum.

Locality.—Melbourne, Sept., 1908, per Mr. W. T. Kendall. The existence of this tapeworm has previously been recorded for N.S.W. and Queensland, and possibly for Victoria. Those brought to me represented a very large number found all along the ileum and also in the caecum of a horse which had been killed for dissection. The small intestine is not so common a habitat for this species as the caecum. Mr. Kendall states that tapeworms are "very common" in horses here, but that he has "never known them to produce any characteristic symptoms, and as they are found in nearly all old horses, he is of the opinion that they do little harm."

No. 2.—Cysticercus pisiformis, Zeder.

This simple cystic stage of *Taenia serrata*, Goeze, has been found in considerable numbers in the rabbits used in the Biological laboratory during 1908, and has also been sent in from numerous other localities, so that it would appear to be widespread in Victoria.

Host.—Rabbit: all parts of the peritoneum are subject to the presence of these cysts.

Locality.—General in Victoria. Per Mr. A. Hart (Freezing Works), etc.

Previously recorded for N.S.W. and Victoria (v. pt. i., Census.).

No. 3.—Echinococcus polymorphus, Diesing.

= *Echinococcus hominis.*

= *Echinococcus multilocularis.*

= *Echinococcus veterinorum*, Rud.

These cysts forming the asexual generation of *Taenia echinococcus*, v. Sieb., have been very prevalent in rabbits in Victoria during 1908, both those brought to the Biological Laboratory, and those used as food, a large number having been sent to me from the Freezing Works. They have been found in almost all of the organs lying in the abdominal cavity, liver, kidney, uterus, etc., in the peritoneum and also in the muscles of the body wall or limbs. The complexity and size of the cysts vary greatly with age, while the cyst wall itself may be very thin, semi-transparent and fragile, or tough and fibrous.

I have also received from the Veterinary College here the kidney of a horse deformed by two deeply-seated cysts which appear to belong to this species. It is stated by Mr. Kendall to be very rare.

Host.—Rabbit: abdominal organs generally, per Mr. Dombrain, June, 1893, and Mr. A. Hart (Freezing Works), July, 1908; horse kidney, per Mr. W. T. Kendall, Melbourne Veterinary College.

Locality.—Various in Victoria.

Previously recorded for Victoria in Man "and Lower animals" (v. part i., Census).

No. 4.—Coenurus serialis (?), Baill.

This is represented in this collection by one cyst, 21 mm. long and averaging 18 mm. in diameter. In the present cyst the scolices are seen to be arranged in groups along 6 nearly radial lines on the inner side of the somewhat fragile cyst-wall. The head of the scolex conforms in general with the characters of Taenia serialis, the hooks varying in number from 27 to 30, and in general shape resembling the typical hooks of this species. In size, however, the hooks of this specimen are much smaller in size—viz., the larger .092 mm. long, and the smaller .064 mm. (as against .135 and .085 mm. and upwards).

Host.—Rabbit.

Locality.—Victoria (?).

Taenia serialis (?) has been recorded previously from Australia but once only, by Cobb, in a dog from N.S.W. The hooks there, however, are larger than the typical ones.

C. Nematodes.

No. 1.—Sclerostomum edentatum, Lss., 1901.

= *Sclerostomum equinum* (O. F. Mueller, in part) (v. Looss, '01, p. 77).

Sclerostomum.—Four specimens, all females. Lengths, 33 mm., 33 mm., 42 mm., 43.6 mm., and thickness, 1.75 mm., 2 mm., 1.75 mm. and 2 mm. respectively. The greater thickness of the head, as compared with that of the body generally,

and given by Looss as characteristic of this species, is clearly seen in these specimens. The mouth capsule is cup-shaped, and contains no teeth. The elongated triangular shape of the "dorsal gutter," as seen in transverse section exactly agrees with that described by Looss in his specific diagnosis. Oesophagus:—In length these are 1.75 mm., 1.55 mm., 1.95 mm., 1.86 mm., and in thickness, minimum .42 mm., maximum .54 mm.; minimum .39 mm., maximum .54 mm.; minimum .33 mm., maximum .48 mm.; and minimum .4 mm.; maximum .6 mm. respectively. It will be seen from this that the oesophagus is rather thinner than that quoted by Looss for *Scl. edentatum*, and about the same as that of *Scl. equinum* (s.s.) but on comparing the transparent head of these forms with Looss' figures (pl. i., fig. 11, etc.) of the two species, there is no doubt that these 4 specimens belong to *Scl. edentatum*, quite apart from other points of similarity. The same relation between the widths of oesophagus and body and the same sudden enlargements of the oesophagus behind the nerve ring, are here seen.

The excretory pore opens far forward on the head, but the cervical papillae are not visible in any one of the 4 specimens. The great thickness of the skin is especially well seen in two individuals, and in all "the slight general torsion of the body round its long axis." The female opening is, except in one specimen, curiously indistinct. In that one, the first of those named above, the vulva is still surrounded by the peculiar brown cement, and so its position, 8.25 mm. from the anus, is clearly seen. But it is very indefinite in each of the others—it appears in them to vary between 7.5 mm. and 11 mm. in front of the anus. The blunt tail of Scl. edentatus is seen here.

Host.—Horse: stomach (and intestines ?).

Locality.—Horsham, Victoria; June, 1903.

Not previously recorded (as such) in Australia.

No. 2.—**Sclerostomum vulgare**, Lss., 1901.

= *Sclerostomum armatum*, Rudolphi, according to Poeppel (v. Looss, '01, p. 78).

Sclerostomum.—14 females, 1 male. Lengths, male 15.6 mm., females 18 to 23 mm. (average 19.3 mm.); thickness, male .94

mm. maximum (average .75 mm.), female .8 mm. maximum (with average .75 mm.) to 1.29 mm. (with average 1 mm.). The diameter of the male is nearly constant for the whole length, while that of the female is greatest in the middle region of the body, tapering to each end, but anteriorly truncate and posteriorly pointed. No distinction in size between the head and the rest of the body. Buccal cavity cup-shaped, widest near anterior end. Dorsal gutter hemispherical and slightly grooved in transverse section. The single tooth at the base of the dorsal gutter shows the double earlike lobes typical of this species. The excretory pore and cervical papillae are rarely seen, but when visible are in the region of the nerve ring. The length of the oesophagus is—male 1.17 mm., female 1.3 to 1.76 mm. (averaging 1.5 mm.). Its maximum diameter is—male .3 mm., female .3 to .53 mm. (averaging .44 mm.) The bursa of the male exactly resembles that figured by Looss ('01, pl. ii., fig. 18). The female opening varies in position somewhat, being situated from 5.25 mm. to 7.48 mm. from the posterior extremity. As stated above, the tail is pointed, differing in this from *Sclerostomum edentatum*. From this descrition it may be seen that these individuals exactly agree with the description given by Looss of *Sclerostomum vulgare*, in all respects except some of the measurements, where slight differences are found. Thus in some of the females, the vulva is somewhat nearer the posterior end, in the male the length of the oesophagus is slightly less, and the maximum diameter of the oesophagus is a little greater than those quoted by Looss for *Scl. vulgare*. But these points are not by any means sufficient to invalidate this identification, in view of the great number of details in which there is a complete agreement with the diagnosis given by Looss.

Host.—Horse: stomach (and intestines (?)).

Locality.—Horsham, Victoria, June, 1903.

No previous record for Australia.

No. 3.—**Triodontophorus intermedius**, n. sp.

(See Plate XXIX., Figs. 1, 2, 3).

This species in some respects combines the characters of *Triodontophorus minor* and *Tr. serratus*, Looss ('01, p. 78); in

others it comes intermediate between those two species. One is tempted at first sight from some of the linear proportions to regard it as an immature form of *Tr. serratus*, but that is seen to be out of the question on examination of the reproductive organs, which are fully mature. On the whole, it is more satisfactory to separate it from that species. So far as the material in hand, consisting of three females, is concerned, its specific characters appear to be the following:—

Triodontophorus.—Length, ♀ 16.9 to 20.25 mm. (average 18.4 mm.); maximum diameter ♀ .6 to .83 mm., average diameter .48 to .66 mm., so that the body is somewhat more slender than either *Tr. minor* or *Tr. serratus*, and also more pointed both anteriorly and posteriorly. Head not usually separated from body. Mouth collar, as in *Tr. serratus*, not appreciably depressed. Parts of external leaf-crown and capsule teeth 36 to 44. Mouth capsule .12 to .15 mm. in length, and usually about .15 mm. in extreme diameter. It is therefore generally similar in shape, though not size, to that of *Tr. serratus*, but in the case of the longest specimen, which is similar to or intermediate between the remaining two individuals in other respects, the capsule was longer and narrower, as in *Tr. minor*, though differing in size from that, being .15 mm. in length, and only .11 mm. in diameter. Teeth generally .04 mm. long, as in *Tr. minor*, but showing the more serrated edge found elsewhere in *Tr. serratus*. In the longest individual—that mentioned above—the teeth were .048 mm. long, and the denticulation of their anterior edges was not so marked as in the other two individuals. Oesophagus, same general shape and average length as in *Tr. minor*; maximum diameter .16 to .21 mm., minimum .07 to .084, i.e., slightly thicker than *Tr. minor*, and less than in *Tr. serratus*. Excretory opening as in the two original species, i.e., just behind the nerve ring. The cervical papillae appear much nearer the median ventral line than in *Tr. minor* or *Tr. serratus*.

Female opening 1.32 to 1.54 mm. from tip of tail, and anus .28 to .31 mm. from tip. In each of these respects this species is intermediate between *Tr. minor* and *Tr. serratus*. In general appearance the tail more closely resembles that of *Tr. serratus* than that of *Tr. minor*.

Host.—Horse: stomach (and intestines (?)).

Locality.—Horsham, Victoria; June, 1903.

Two types in the museum of the Biological Department of the University of Melbourne.

Remarks.—The marked intermediate character of these three specimens raises a suspicion in one's mind as to the validity of the separation of the forms described as *Tr. minor*, *Tr. serratus* and *Tr. intermedius*, into distinct species. But in view of the small amount of material of *Tr. intermedius* available, and of the geographical isolation of this country, it has seemed wiser in the interests of clearness to make a new species of these three specimens, the only representatives of the genus yet known in Australia. Unfortunately the material was in a very unsuitable condition for histological examination.

No. 4.—Cylichnostomum poculatum, Lss., 1901.

Cylichnostomum.—1 female. Length, 9.6 mm. Head not constricted off from body; skin annulated. Mouth collar flattened, and cut off from skin. External leaf-crown has approximately 36 long, fine teeth, with tips projecting beyond mouth-collar. Submedian head-papillae long, flattened, and with tips apparently constricted; lateral head-papillae not conspicuous. Depth of mouth capsule equal to its external diameter; walls thin anteriorly but becoming thicker posteriorly. Internal leaf-crown typical, the elements being short and thick. Dorsal gutter conspicuous but short. Excretory pore and cervical papillae in region of nerve-ring. Oesophagus, length .84 mm., maximum diameter being .13 mm., and minimum diameter .078 mm. Transverse section of intestine oval, being flattened laterally. Tail long, broad at base and tapering to tip. Anus .33 mm. from tip and .156 mm. behind vulva.

Host.—Horse: stomach (and intestines (?)).

Locality.—Horsham, Victoria; June, 1903.

Not previously recorded from Australia.

No. 5.—Cylichnostomum sp. (c.f. poculatum), Lss., 1901.

Associated with the specimen just described of *C. poculatum* was another individual (female) 10 mm. long, having in general

the specific characters of that species, but differing in one or two linear dimensions which vary in such a way as to make it probable that it may represent a new species not included in those described by Looss. But in view of the paucity of material, and of the fact that the head, which, however, appears to resemble that of *C. poculatum*, is badly damaged, it is wiser at present to regard this individual as a variety allied to this species. The points in which it shows a difference from the species named are as follow:—Oesophagus, length .7 mm.; distance from anus to tip of tail, .42 mm. Vulva .07 mm. in front of anus: i.e., the oesophagus is 1 mm. shorter in a longer individual of the same sex, preserved together and apparently of similar condition of maturity; the tail also is .12 mm. longer than the longest recorded of the original species, while the distance between anus and vulva is only two-fifths of that of *C. poculatum*. These variations do not appear attributable to distortion during preservation, since Nos. 4 and 5 have been preserved together throughout, or to individual variations of any kind, since they do not show any conformity with each other.

Host.—Horse: stomach (and intestines (?)).

Locality.—Horsham, Vic.; June, 1903.

Not previously recorded from Australia.

No. 6.—Cylichnostomum sp.

Another of this series of specimens is a small agamous *Cylichnostome*, which, I believe, belongs to *C. poculatum*, but which is hard to determine owing to the much contracted condition of the head region, and the absence of reproductive organs and opening. The chief determinable features of specific value are as follow:—Length of worm 4.8 mm., extreme diameter .18 mm. Length of mouth capsule equal to greatest diameter. Walls thin anteriorly, becoming thicker posteriorly, curved to form a much swollen cylinder. Dorsal gutter short. Oesophagus, length .276 mm., maximum diameter .036 mm., minimum diameter .024 mm. The intestine is abnormal in showing no sign of pigmentation. Anus .12 mm. from tip of tail, which tapers from the somewhat broad base to the tip. No reproductive organs or openings are present.

Until further material is available for comparison, I prefer to regard this as of indetermined species, but probably a small agamous *Cylichnostomum poculatum.*

Host.—Horse: stomach (and intestines (?)).

Locality.—Horsham, Victoria; June, 1903.

No. 7.—Cylichnostomum calicatum, Lss., 1901.

The last of this series of specimens consist of 4 individuals of *Cylichnostomum,* 3 males and 1 female. Length of males 5.52 to 6.06 mm., extreme thickness .21 mm.; female 6.06 mm. long and .24 mm. maximum diameter. Head slightly tapering anteriorly, but not constricted off from body. Mouth collar slightly flattened, but less so than in *C. poculatum,* set off from rest of head. External leaf-crown consists of 8 to 10 broad parts with rounded tips, which project slightly beyond mouth collar. Submedian head papillae long, with broad bases and tips constricted off. Lateral papillae small. Mouth capsule as long as it is wide, cylindrical, with almost straight walls, which are thicker than in *C. poculatum.* The elements of the leaf-crown are short and stout, and project from the anterior margin of the mouth capsule. The dorsal gutter is very long and generally seen projecting nearly to the anterior margin of the buccal capsule. The cervical papillae in one case were between the nerve-ring and excretory pore, as is typical, otherwise all three organs were nearly in the same place. Oesophagus.—This is somewhat disproportionately shorter that the original description gives, viz., .33 mm. in the male and 34 mm. in the female, but the ring-like enlargement of its anterior end is well seen. The maximum thickness of the oesophagus varies from .06 mm. in the male to .078 mm. in the females, its minimum thickness being .03 mm. in the male, and .042 mm. in the females.

The characters of the bursa in the male show no marked difference from the figure given by Looss [loc. cit., pl. ix., fig. 117], while all the characters of the head end are in complete agreement with both original description and figures. The tail of the female is very short (.06 mm.), pointed, and cut off abruptly from the body. Distance of vulva from anus .07 mm. (i.e., shorter in these worms proportionately to their shorter length).

Host.—Horse: stomach (and intestines (?)).

Locality.—Horsham, Victoria; June, 1903.

No previous record for Australia.

It is worthy of note that all the Nematode species recorded here, up to this point, were obtained together from the one horse, and of course may have been accompanied by others—certainly a most varied fauna in comparison with its small total number—viz., 3 genera, 5 definite species and two others indefinite, in a total of 29 individuals. It will be noticed that the habitat given for all these preceding forms differs from that given by Looss—thus all the species of *Sclerostomum* and *Cylichnostomum*, and *Triodontophorus serratus* are found normally in the caecum, and the 1st third of the large loop of the colon, *Tr. minor*, living in the last part of the colon. Here, however, the information accompanying the material is "stomach (and intestines (?)) of horse." Also as regards *Triodontophorus*, Looss remarks that the individuals are "very constantly found firmly fixed to the mucous membrane of the host's intestine." Whether any of my specimens were so attached when found, I am unable to say, all the specimens on which these records (Nematodes Nos. 1-7) being preserved free in a glass tube, and unaccompanied by any information on this point.

No. 8.—Ascaris megalocephala, Cloq;

=*Ascaris equorum*, Goeze.

Fifty-one specimens of this common species of other countries were brought to me from the intestines of a horse. Their length varied from 17-23 cm., their diameter from 4-7 mm. The males and females were in nearly equal numbers. Owing to their having been kept for some time before reaching me, they showed a tendency to contract greatly on being put into formalin and spirit, the body walls shrinking away in many cases from the cuticle. The head end, unlike the tail, did not leave the cuticle, but became sharply bent ventrally, so that often the mouth was directed posteriorly instead of anteriorly. The general characteristics of these specimens are normal. A number of individuals have been picked up in various parts.

One of these, a female, was only 14½ cm. long and 4 mm. in diameter; another female found in the scrub in Tasmania was 37 cm. long and 10 mm. in extreme diameter, while the third, a male picked up near the horse-market in Parkville, Victoria, was 27 cm. long and 8 mm. in diameter. The female opening in all cases was almost exactly ¼ of the body length from the anterior end.

Host.—Horse: intestines.

Locality.—Abattoirs, Newmarket, July, '08, per Mr. J. Robertson; Camberwell, Vic., 1904, and Parkville, Vic., 1904, and Tasmania, 1905.

Previously recorded from South Australia, New South Wales, and Bismarck Archipelago, and probably Victoria (see Part I., Census).

No. 9.—**Ascaris lumbricoides**, L., 1758.

This common parasite of man is represented in this collection by 18 worms, chiefly female, sent from the Children's Hospital. The specimens are normal in character, except that some apparently immature are below the usual size. The males vary from 10 to 14 cm. in length, and 3 to 5 mm. in diameter; the females from 13½ to 30 cm. in length and 4 to 6 mm. in diameter. The teeth and sense papillae on the oral lips are not at all easily seen, though they can be detected in a few cases. The female opening is situated typically at one-third the body length from the anterior end. The tail of the male tends to coil ventrally in a vertical plane. The two spicula are equal in length and similar in shape.

Host.—Child: no details of habitat are given, but presumably the worms were found, as usual, in the small intestine.

Locality.—Melbourne, 1897, per Dr. Officer.

No previous definite record for Australia, though doubtless well known.

No. 10.—**Ascaris canis**, Werner, 1782.

=*Lumbricus canis*, Werner, 1782.
=*Ascaris teres*, Goeze, 1782.
=*Ascaris cati et caniculæ*, Schrank, 1788.

=*Ascaris canis et felis*, Gmelin, 1789.
=*Ascaris tricuspidata et felis*, Brugière, 1791.
=*Ascaris werneri*, Rudolphi, 1793.
=*Fusaria mystax*, Zeder, 1800.
=*Ascaris marginata et mystax*, Rud., 1802.
=*Ascaris alata*, Bellingham, 1839.
(v. Braun, '06, p. 336.)

Sixty-five specimens, forty female, twenty-five male. These are distinctly reddish in tint. The females vary in length from 7½ to 10½ cm., and the males from 5 to 8½ cm. The head of both sexes shows the characteristic curve, the tail of the male being curved in 1½ turns or less. The membranous wings on either side of the head are very conspicuous in some specimens and may have crinkled edges when large. The membranous wings on the tail are not very marked. In addition I have two specimens from a cat, one a male, measuring 5.5 cm., the other a female 9 cm. long. These are creamy white in colour.

Host.—Dog and cat: intestine.

Locality.—Not known, Victoria probably.

Previously recorded only as *Ascaris mystax*, from cat, New South Wales (v. Part I., Census).

No. 11.—Ascaris marina (Linn.). (Immature).

= *Gordius marinus*, Linnæus, 1766.
= *Cucullanus salaris*, Goeze, 1782 (?).
= *Gordius harengum*, Bloch, 1782.
= *Cucullanus lacustris*, *var. salaris*, Gmelin, 1788.
= *Ascaris marina*, Gmelin, 1788-1793.
= *Ascaris halecis*, Gmelin, 1788-1793.
= *Cucullanus halecis*, Fabricius, 1794.
= *Filaria marina*, Rathke, 1799.
= *Ascaris capsularia*, Rud., 1801 (pt. i., etc.).
= *Filaria capsularia*, Rud., 1801 (pt. ii. and iii., etc.).
= *Spiroptera hominis*, Rud., 1801 (?)
= *Capsularia halecis*, Zeder, 1803 and 1820.
= *Capsularia trinodosa*, Zeder, 1803.

= *Fusaria marina*, Zeder, 1803.
= *Filaria piscium*, Rud., 1808-1810, etc.
= *Capsularia salaris*, Zeder, 1820.
= *Strongylus gigus* (young), Bremser, 1824 (?)
= *Spiroptera rudolphi*, Delle Chiaje, 1825 (?)
= *Filocapsularia*, Deslongchamps, 1791 to 1827.
= *Agamonema piscium*, Diesing, 1850-1.
= *Agamonema capsularia*, Diesing, 1850-1.
= *Filaria* (?) *marina*, Baird, 1853.
(see pl. XXIX., figs. 4, 5, 6, 7).

The specimens on which this record and description are based were forwarded to me by Dr. A. A. Brown, of the Victorian Department of Agriculture, through the courtesy of Mr. S. S. Cameron, Chief Veterinary Officer for Victoria. These Nematodes, which Dr. Brown has named in the daily press "Strongylus spiralis piscium," are apparently very prevalent in Victorian fish, being found in the peritoneum. The mass (12 by 20 mm.) in my possession, which was taken from Barracouta, consists of approximately 60 worms, each individual tightly coiled in a flat spiral about 3 mm. in diameter. and having 2½ to 3½ coils, these coils being arranged in 3 to 5 layers thick. They are whitish in colour and opaque. Surrounding each is a somewhat loose covering, and the mass is bound together by a tough fibrous capsule, which encloses each, and makes it a matter of considerable difficulty to separate them from one another, especially as the rigidity of the body causes the worm to break rather than uncoil. As stated above, each is enclosed in a loose, slightly wrinkled cuticle-like investment which can be, with care, drawn straight off from the anterior or posterior end of the contained animal like a glove finger, leaving the entire animal behind; also, the main features of the animal can be seen through this membrane, which assumes the external shape of the enclosed worm.

The several dimensions of the body of three typical individuals are as follow :—

	A mm.	B mm.	C mm.
Length	27	30	25
Diameter of head	.144	.12	.12
" " 1 mm. back	.3	.24	.24
Maximum diameter of body (near middle	.399	.45	.43
Length of œsophagus	2.34	2.46	2.46
Length of intestinal diverticulum	.693	.66	.72
Diameter of body, 1 mm. from posterior end	.339	.312	.255
Diameter at anal aperture	.05	.099	.12
Tail (anus to tip) length	.078	.078	.102

The body tapers both anteriorly and posteriorly, but more gradually anteriorly. The head end is also often less sharply coiled than the remainder of the body. The tail is short and conical, the extreme tip being mucronate with transverse ridges. The body has regular and fine transverse striations. On the head one can occasionally make out a more or less rudimentary division into 3 lips, which, however, is often quite obscure. Only rarely are head papillae visible, but on the anterior face of the head is a minute conical spine with spreading base, resembling in outline that of the spine on a placoid fish scale, the obtuse apex being directed outwards. No alae are to be seen as a rule (though one specimen has one .033 mm. in width, the tail of this form being short), nor postanal nor preanal papillae.

In the three specimens of which the sizes are given above, A with a short tail has no papillae and very indistinct lips, B, also with a short tail, has 3 distinct lips and rudimentary papillae, C with a long tail has no papillae and fairly distinct lips.

A well-marked diverticulum passes forwards from the intestine where it joins the constricted oesophagus, and lies alongside the latter. The diameter of this diverticulum is greater than that of the intestine itself, and completely hides the oesophagus from view where it is present. No reproductive organs could be detected. I have been unable to find any pearl-like concretion

in the middle of the coiled animal, such as that described and figured by J. Johnstone from the gurnard (1905, p. 297). On reference to the work of Cobbold, Leidy and others, especially that of Prof. Linton (U.S.A.), it is evident that these encysted nematodes are very closely allied to, if not the same species as, those found "encysted and encapsuled" in the peritoneum in such fish as herring, mackerel, cod, salmon and shad, in the Northern Hemisphere. The cuticular covering described above is the embryonic cuticle in which these worms are still enclosed, the enclosed worm being apparently an immature Ascaris, the jaws, etc., of which are insufficiently developed to allow of exact specific determination. The varying stages of development found in the mass at my disposal resemble closely those found by Linton in different fishes, in (loc. cit., 1901), pl. x., fig. 115; pl. xi., figs. 121, 127; pl. xii., figs. 132, 143; pl. xiii., figs. 148, 162, 163; pl. xiv., figs. 168, 179, 181, the most characteristic resembling figs. 143, 162, 163, 168, 179 and 181, from a number of different fishes. I have found, also, that the same individual will give a different appearance of developmental stage of the anterior end according to the clearing reagent used. Those drawn by myself were cleared in carbolised absolute. As it is unlikely that the young of different species would be so closely and similarly intertwined with each other, it seems highly probable that some at least of Linton's "Ascaris spp. immature" will be found to be different stages of the same species.

Now as to the name to be applied to these forms. In the British Museum Catalogue of Entozoa (1853) are records and synonyms by Dr. Baird of 2 Nematodes found in the peritoneum of fish—viz.:—

Filaria (?) *marina* (page 7).
= *Gordius marinus*, Linnæus, etc.
= *Gordius harengum*, Bloch.
= *Ascaris marina*. Gmelin.
= *Ascaris halecis*, Gmelin.
= *Cucullanus halecis*, Fabricius.
= *Capsularia halecis*, Zeder.
= *Fusaria marina*, Zeder.
= *Filaria marina*, Rathke.
= *Filaria capsularia*, Rüdolphi, etc.

= *Filaria piscium*, Rudolphi, etc.
= *Filocapsularia*, Deslongchamps,

from peritoneum of shad, etc.

And, on page 22, *Ascaris capsularia*,

= *Cucullanus salaris*, Goeze.
= *Cucullanus lacustris, v. salaris*, Gmelin.
= *Capsularia salaris*, Zeder.
= *Ascaris capsularia*, Rudolphi, etc.
= *Capsularia trinodosa*, Zeder,

from abdominal organs and peritoneum (?) of Coryphene.

Leidy in his Synopsis of Entozoa (1856, p. 42-58) gives *Agamonema capsularia* (?), Diesing, as found, as well as in the intestines, "coiled in sacs of peritoneum" of shad, herring, etc., and having as characteristics, "Body slender, most narrowed anteriorly, mouth small, circular, surrounded by an undivided lip. Tail short, obtusely conical, minutely mucronate, etc."—a description which closely fits the less developed of my forms.

In Cobbold's "Entozoa," p. 406, we find:—

Spiroptera hominis, Rud., Owen, Duj. and others.
= *Spiroptera rudolphi*, Delle Chiaje.
= *Strongylus gigas* (young of), Bremser.
= *Filaria piscium*, Rud., Siebold, Schneider, etc.
= *Gordius marinus*, Linnæus.
= *Agamonema piscium*, Diesing.

with the cod and haddock as hosts (and, doubtfully, man); the description given by Schneider of this form ('62, p. 302) being "Asexual nematoid in abdominal cavity, and among the muscles of several marine fishes," and having 3 indistinct labial lobes, one of which supports a tooth, "the oesophagus having posteriorly a caecal prolongation." This agrees with some of my specimens, as regards the head at all events.

Cobbold (1865, p. 325) further records the finding of *Filaria capsularia* on liver of hemp fish, in Manchester.

Leidy (1878, p. 171) mentions *Filaria capsularia*, Rudolphi, as a synonym of *Agamonema capsularia*, Diesing—found in Europe in the herring, mackerel, cod, salmon, etc., and in America in shad and herring.

In 1888 we find a record by Linton (p. 454) of *Agamonema capsularia*, Diesing, "encysted and encapsuled in peritoneum," especially in *Lophius*, sp.

In 1888, also, Leidy (1888,[1] p. 166-168) adds the Rock fish to the list of hosts of *Agamonema capsularia*. In the same year, Leidy (1888,[2] p. 211-217) gave *Agamonema capsularia*, Diesing, as a synonym for *Gordius marinus*, Linnæus, which he finds encysted in peritoneum around the stomach and intestines, etc., often forming "flat and close spiral coils on viscera or appended to them." In this same paper he gives the *Agamonema* of the Herring as differing in several details from that of the shad—and according to his description neither of these exactly resembles the specimens herein described.

These encapsuled and immature Nematodes have been dealt with still more fully since that date by Linton. Thus in 1895 (p. 111) he says:—"I have been able to refer some of them to species described by Leidy and others. Some agree superficially with *Agamonema communis*, for example, but upon closer examination will be found to be covered by a thin investment which itself bears the distinguishing characters of *Agamonema*, while within this investment is a nematode which is plainly an immature *Ascaris*." This, as may be seen on comparison with the description of these Victorian forms, is exactly what I have found here. Linton continues: "Specifically identical forms may be encysted in the body cavity, and free in the intestine of the same fish." *Ascaris capsularia* is also recorded by Zschokke (p. 775) as present in *Salmo salsar* (peritoneum). In a later Bulletin (1899, pp. 267, 407, etc.), Linton states in addition that these young Ascarids are too doubtful in specific characters to enable one to give them specific names, as the individuals in the same host, at the same time and place, may differ considerably from one another. That also is true of my specimens. *Agamonema capsularia* and *Ascaris capsularia* are definitely accepted as synonyms by Linton (1901, p. 444) when considering the numerous parasites found in the fishes of the Woods Holl Region. This makes the chain of synonymy complete, as given at the head of this section. Thus, according to Dr. Baird and Cobbold, *Gordius marinus*, Linn. = *Filaria piscium*, Rud., each of these being synonyms of *Filaria*

capsularia, Rud. (v. Dr. Baird). Leidy gives *Filaria capsularia*, Rud. = *Agamonema capsularia*, Dies., and *Gordius marinus*, Linn. = *Agamonema capsularia*, Dies; while Linton, in giving *Agamonema capsularia*, Dies. = *Ascaris capsularia*, Rud., links on the synonyms of *Ascaris capsularia*, Rud. Numerous other references have been consulted in this connection, but as they simply corroborate what has been given above, and add nothing fresh to the discussion, I have omitted them. It would thus appear that the name for this admittedly indefinite species should be *Ascaris marina* (Linn.), and as I have not been able to discover any reason why Linnæus' species has been rejected, especially by Leidy (who calls attention to its synonymy), I have used this as being the more correct name, in preference to the commonly accepted name, *Ascaris capsularia*, Rud.

Possibly there has been a confusion of a number of species very closely related in general appearance and habit. Linton only regards them as *Ascaris* species, their immaturity and the variability they display even where the differing specimens are almost certainly of one species, rendering it difficult to distinguish them specifically. Much of this variability is doubtless simply due to difference in the stage of development, so that the number of adult species represented by these varying forms will be very much less than appears at first sight when examining them.

As the early descriptions given by Leidy of *Agamonema capsularia*, Dies. (*Gordius marinus*, L.) so closely agree with the forms in my possession, it seems justifiable to designate them *Ascaris marina*, Linn., even in the light of the possibility of several species being confused under one specific name, and the impossibility of my being able to determine at present the exact original form described under the specific name of *marinus*. At the best, the name is one given to an immature Ascarid.

Host.—Barracouta.

Locality.—Port Phillip, Victoria; Nov., 1908.

No previous record from Australia.

No. 12.—Gongylonema scutatum, Leuckart, 1876.

There has come into my hands from Mr. Robertson, Government Veterinary Surgeon, per Mr. S. S. Cameron, a bottle containing "Portion of Rumen of Cow, worm attached, Sept., '98," and bearing an additional label with the following note:—"*Gongylonema scutatum* (Leuckart, 1876), natural habitat oesophagus—no previous record as being in Rumen (Neumann, '98)," this specimen having been identified by Neumann in 1898. As I have been unable to find any record of the occurrence of this worm in Australia, I am including it here.

There are 2 specimens, both females, one unattached being 12 cm. long, the other, of which the anterior part is embedded in the wall of the rumen, has an exposed length of 7 cm. The cuticular plates around the otherwise unarmed head end are very well marked, varying considerably in size. The tubular pharynx .55 mm. long, is succeeded by an oesophagus 8.8 mm. long, the posterior end of the latter having a club-shaped swelling .26 mm. in diameter.

The posterior portion of the body is closely packed with ova.

Host.—Cow: rumen.

Locality.—Victoria; Sept., 1898.

No previous record from Australia.

D. Nematomorpha.

E. Acanthocephala.

F. Insecta.

G. Arachnida.

No. 1.—Hypopial nympha of Falculifer rostratus (?) (Buchholz, 1869), Railliet, 1896.

= *Falciger rostratus*, Buchholz, 1869.
= *Hypodectes columbae*, Solarski, 1877.
= *Hypoderas columbae*, Murray, 1877.
= *Hypodectes minor* (?).

(see pl. XXIX., figs. 8, 9).

During the dissection of pigeons in the Biological Laboratory here, a number of small organisms were found in the connective

tissue around the roots of the pectoral blood-vessels and in the pericardium by Dr. T. S. Hall, who brought them to me. Careful examination of them and consultation of such literature as was available to me, showed that these forms are really the "hypopial nympha," or second stage in the life-history of one of the feather-feeding Sarcoptidae, probably of *Falculifer rostratus* (Buchholz, 1869), Railliet, 1896.

This and similar forms—known variously as *Acarus muscarus*, Linn., *Acarus spinitarsus*, Hermann, 1757, then *Hypopus*, Duges, 1834; *Homopus*, Koch, 1843, and later as *Hypodectes*, Filippi, 1861, and *Hypoderas*, Frauenfeld, 1864—have been the subjects of a long discussion, dating from 1735, but closed for the time being by the work of Megnin (1879, p. 120) and that of Michael (1884, p. 371).

These parasites, as previously described by several—viz., Michael, and also figured by Ch. Robertson (1866, p. 201)—are white, elongated, rounded animals, maggot-like in general appearance, .92 to 1.24 mm. long, and .16 to .31 mm. wide. The skin is soft and easily wrinkles. No median transverse groove was visible, nor were rostrum, mouth appendages or alimentary canal to be seen. Four pairs of short jointed legs are present, the two posterior pairs being situated a considerable distance behind the 2 anterior pairs. Each leg has 5 joints, not always clearly defined, the last bearing a number of hairs, one or more of these hairs being much longer than the others. The bases of the two anterior pairs of legs are associated with a curious darkly coloured chitinous-like support on the ventral surface of the head, while another similarly constituted but differently arranged structure is found on the ventral surface of the body, between the 2 posterior pairs of legs. These two masses form a most conspicuous and characteristic feature in the appearance of the parasite. The form here recorded is closely similar to that figured by Robertson, but I am adding hereto two figures, one of the dorsal surface of the head, and one of the ventral surface of the body, for comparison. As I have not the adult stage of this form, I have not been able to completely verify this identification.

According to Mégnin's researches (loc. cit., and see also Neumann, p. 214), this much reduced form is a peculiar stage

in the life-history of the itch-mite of the pigeon. There is found in this case, a deviation from the normal metamorphosis, inasmuch as this additional stage, or "hypopial nympha" is introduced between the second stage or normal "nympha" and the young adult. The "hypopial nympha" is formed from the normal "nympha," according to Mégnin, under conditions in which there is an undue lack of nourishment or warmth in the feathers on which the adult lives. The "hypopial nympha" then passes down from the surface of the body through the feather follicles into the connective tissues below, where it lives by absorption from the surrounding tissues until such time as it may safely return to the surface and become changed into the adult form. According to Michael (1884, p. 390), the formation of this "hypopial nympha," in some forms at least, takes place quite "irrespective of adverse conditions," and only in the case of a few individuals, being "a provision of nature for the distribution of the species," in other words, simply a protective travelling dress. It would seem, however, that in the case of the "hypopial nympha" herein recorded, Mégnin's conclusions are more probable. This is, so far as I have been able to find, the first record of the existence of this form in Australia, though it is evidently well known in Europe, and is also found in the United States of America (v. Hassall).

Host.—Pigeon: in connective tissue around roots of pectoral blood vessels, and on the pericardium around entrance of inferior vena cava.

Locality.—Melbourne, Vic.; September, 1908, per Dr. T. S. Hall.

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EXPLANATION OF PLATE XXIX.

All Figures are outlined by the aid of the Camera Lucida.

Fig. 1.—*Tridontophorus intermedius*, n. sp., × 2, showing proportions of animal, and female opening.

Fig. 2.—Anterior end of same, × 42.

B.C. = Buccal capsule.
C.P. = Cervical papillæ.

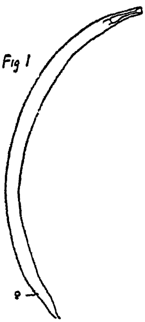

Fig 1

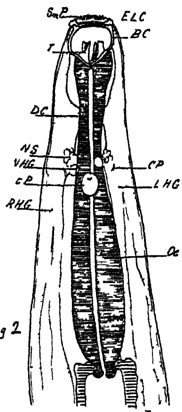

Fig 2

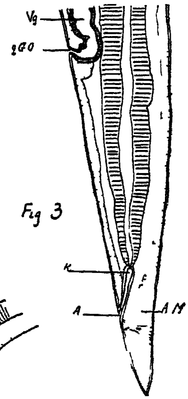

Fig 3


Fig 4

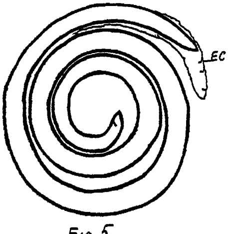

Fig 5

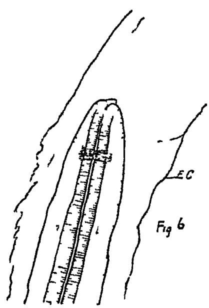

Fig 6

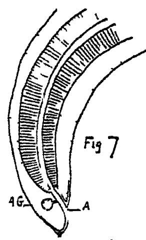

Fig 7

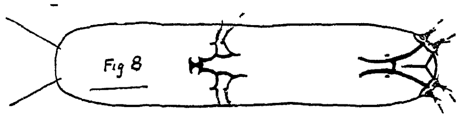
Fig 8

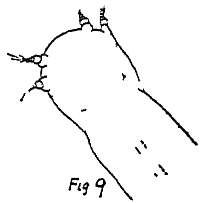
Fig 9

D.C. = Dorsal connection of head glands.
E.L.C. = External leaf-crown.
E.P. = Excretory pore.
L.H.G. = Left head gland.
N.H.G. = Nuclei of head glands.
N.S. = Nervous system.
Oe. = Oesophagus.
R.H.G. = Right head gland.
Sm.P. = Submedian papillæ.
T. = One of the three teeth.

Fig. 3.—Posterior end of same, × 33.

A. = Anus
A.M. = Anal muscles.
♀G.O. = Female generative opening.
R. = Rectum.
V. = Vagina.

Fig. 4.—Cluster of coiled specimens of *Ascaris murina* lying in connective capsule in peritoneum, × 2.

Fig. 5.—One specimen of same, × 6; showing immature worm lying inside the partly withdrawn embryonic cuticle (E.C.)

Fig. 6.—Head end of same specimen, × 42; showing conical spine on imperfectly developed head, and long straight œsophagus surrounded by nerve ring.

E.C. = Embryonic cuticle.

Fig. 7.—Tail end of same specimen, × 42; showing straight intestine, rectum and mucronate apex of tail.

A. = Anus.
A.G. = Anal Gland.

Fig. 8.—Ventral view of body of "Hypopial Nympha" of *Falculifer rostratus* (?), × 42; showing arrangement of paired appendages and their chitinous support.

Fig. 9.—Dorsal view of head of same.

[PROC. ROY. SOC. VICTORIA, 21 (N.S.), PT. II., 1908.]

ART. XXIV.—*On the Separation and Analysis of Minerals in the Dacite of Mount Dandenong, Victoria.*

BY HENRY C. RICHARDS, B.Sc.,

Caroline Kay Scholar in Geology, Melbourne University.

[Read 10th December, 1908].

INTRODUCTION.

As no information was available regarding the composition of the minerals of variable composition in the dacites of Victoria, it was suggested by Professor Skeats that this work should be undertaken; and it was hoped that thereby some light would be thrown on the relation existing between these minerals in the normal dacite, and in the gneissic rocks which he has discovered in contact with the dacite in the Dandenong ranges.

Very little in the way of determining the composition of Victorian rock-forming minerals seems to have been done, and the only record I can find of an analysis of a ferro-magnesian mica is one done by the late Dr. Howitt and published in his paper on the "Rocks of Noyang."[1]

The objects of this research work can be tabled under three heads:—

i. To separate the minerals Biotite, Hypersthene and Ilmenite from the rock.

ii. To analyse them and make a bulk analysis of the rock.

iii. To see what light chemical evidence would throw on the probable formation of secondary minerals in the rock.

THE DACITE.

The sample used in this work was obtained from a quarry alongside the railway line, a little on the Ferntree Gully side of Upwey station, on the Gembrook line, and is believed to be a

1 Proc. Roy. Soc. Victoria, vol. xx., p. 24.

representative sample of the normal dacite in that area. It is a dark-grey, and very hard compact porphyritic rock. In the hand specimen phenocrysts of a dark-brown mica, biotite, in well-formed hexagonal flakes, can be seen, also phenocrysts of felspar, but further than that little else can be observed megascopically. Under the miscroscope in thin sections one can see abundant phenocrysts of plagioclase, generally with regular outlines, and very often zoned, dark-brown biotite, pale-green hypersthene, quartz very occasionally, and an opaque mineral which may be either magnetite or ilmenite, all set in a fine-grained crystalline groundmass of quartz, felspar and biotite.

Of the minerals in the rock the plagioclase felspars can be determined optically by the Michel-Lévy method, and so definite compositions assigned to them; but it is necessary to separate and chemically analyse the minerals biotite, hypersthene, and the opaque mineral in order to learn their compositions.

The proportions of the phenocrysts and groundmass are about equal, and as the average diameter of the former is only .1 mm., it was seen that the separation of them in sufficient quantity and in a pure enough state for a chemical analysis would be a matter of some difficulty.

Methods of Separation Adopted.

The minerals to be separated are all iron-bearing, so that the electro-magnet suggested itself as a means to the desired end; accordingly one as described by T. Crook,[1] of the Imperial Institute, London, was used.

By a combination of the electro-magnet with the use of heavy liquids and various shaking devices, and finally picking with a wet brush underneath the microscope, the minerals were obtained pure enough for chemical analysis.

The electro-magnet consists of a cylindrical piece of soft iron, 1 inch in diameter, bent into U shape and having vertical limbs about 6 in. long and 3 in. apart. Each limb is provided with a bobbin on which is wound seven layers of insulated wire (16 gauge), each layer having about 40 turns. Two pole pieces,

1 "The Use of the Electro-Magnet in Petrography," by T. Crook, A.R.C.Sc.I., F.G.S. Science Progress, No. 5, July, 1907.

consisting of soft iron about 1¼ in. wide and ⅓ in. thick, are slotted so as to move over screw-clamps which fit into the ends of the limbs. By this means the pole-pieces can be adjusted in any desired position.

The electro-magnet is connected with the ordinary lighting circuit of 200 volts alternating current, the latter being converted into direct current by means of a Noden-valve arranged by Mr. Grayson, of the Geological Department. Suitable resistances were obtained by means of ordinary incandescent lamps, 6 of which, of varying capacities, were used, giving an amperage ranging from ½ amp. to 3 amps., the voltmeter indicating 10 volts for the latter value.

Preparation of the Sample.

The fresh representative sample was first crushed into pieces about the size of peas by means of a small jaw-crusher, this material was then crushed up in a steel mortar, so that it would pass through a sieve with openings about .2 mm. square (20 sieve), but remain on a 40 sieve with apertures about .1 mm. sq. This size was found most convenient for the separation of the larger flakes of mica. After the mica had been removed from this it was further crushed so as to be caught on a 60-sieve with apertures .06 mm. sq.

The larger size was more convenient for the separation of the mica, while the smaller size was required for the hypersthene.

Separation of the Minerals.

It was found that the separation of the mica from the hypersthene by means of a magnet could not be done very satisfactorily, but in transferring the powders in cardboard boxes it was noticed that the flaky biotite had a tendency to stick to the bottom of the box, while the other rounded grains rolled off easily. This peculiarity of the mica was utilised, and proved especially valuable, for while the magnet served to separate the mica and hypersthene from the other minerals in the rock, the gentle shaking in cardboard boxes with one end cut away, served to separate the mica from the hypersthene.

Mica.—By means of a bar-magnet all the steel splinters off the mortar, and grains of opaque material that would come out were removed; then the powder was subjected to the electro-magnet with the pole-pieces 4 mm. apart, and all the material which would come out while 3 amperes were run through the magnet was removed.

This magnetic material was made up of free grains of biotite, hypersthene, and composite grains of either or both these minerals with felspar and quartz, or with the magnetic opaque material. By gentle shaking of the cardboard boxes held at a slight angle and with one end cut away, the biotite was separated from the other material, small lots being treated at a time and given several shakings.

By means of Sonstadt's heavy liquid of Spec. Gr. about 3, used with a Sollas Separator, the free biotite was separated from most of the other material, only a few composite grains of hypersthene and mica coming down also. The material was then washed and dried, and the composite grains picked out with a fine wet brush underneath the low power of the microscope. This was a very laborious process, but only in this way could quite pure material suitable for analysis be obtained.

Hypersthene.—The powder whose grains were about .1 mm. in diameter was used for obtaining this mineral. With a voltage of 10 (3 amperes) and pole-pieces 4 mm. apart, the magnetic material, which separated readily, was removed by the electro-magnet. On breaking the circuit a certain amount of material still adhered to the pole-pieces, and was made up of small steel splinters from the mortar, fragments of ilmenite and leucoxene, and in some cases pieces of quartz or felspar containing inclusions of the opaque mineral. The magnetic material separated as above contained grains of hypersthene, biotite, ilmenite, quartz and felspar containing magnetic inclusions, and a fair amount of composite grains of the above minerals.

Under the microscope it was noticed that hypersthene grains very often enclosed large patches of the opaque material.

By means of card-shaking the biotite was removed almost completely. The remaining material was then subjected to a voltage of 3 with pole-pieces 4 mm. apart, the material removed

in this way was seen to be largely the opaque mineral, hypersthene containing large inclusions of the former mineral, leucoxene, and quartz and felspar containing magnetic inclusions. The voltage was then increased to 10 (3 amps.), and all the material was picked up with the exception of a few quartz and felspar grains, and several small flakes of biotite.

By means of Sonstadt's solution of Spec. Gr. 3, used with a Sollas Separator, a practically pure hypersthene product was obtained, the quartz and felspar being removed with the exception of a few composite grains, which were easily picked out with a wet brush.

An examination of the hypersthene under the microscope detected opaque material in nearly every grain, so with a view to getting rid of as much as possible of this it was ground finer in an agate mortar, and subjected to 4 volts, with pole-pieces 4 mm. apart. A good deal of magnetic opaque material was removed thus. After picking over with a wet brush under the microscope, this mineral was ready for chemical analysis.

Ilmenite.—An attempt was made to separate this from the rock powder by the magnet, but as it is present to the extent of only one per cent., is largely included in other minerals, and is in such small grains it would have been a lengthy process to separate enough for a chemical analysis. The separation has been done by nature, however, and some of the material as it occurs in the stream sands in the dacite area was obtained. It is remarkably fresh, and although the sample was not obtained from exactly the same locality as the rock sample, it is believed that its composition is similar to that contained in the material used for separation and analysis.

Analyses of Rock and Minerals.

Besides analyses of the three minerals of variable composition in the rock, one was made of the rock itself. All the analyses were made in duplicate with the exception of that of the ilmenite. Agreement between the duplicates was satisfactory, and the analyses appended below are those of one of the duplicates and not the mean of two determinations.

Analyses of Dacite and Minerals.

		Actual Analyses.				Calculated.	
		A	B	C	D	E	F
SiO_2	-	63.27	39.86	50.42		40.04	55.23
Al_2O_3	-	16.50	11.13	4.06		11.17	4.44
Fe_2O_3	-	0.68	1.39	2.10	none	1.39	2.30
FeO	-	5.10	18.10	23.54	31.92	18.18	22.34
MgO	-	2.48	9.88	13.04	0.80	9.92	14.27
CaO	-	4.18	sl. tr.	1.30		sl. tr.	0.24
Na_2O	-	2.36	0.35	tr.		0.35	tr.
K_2O	-	2.68	6.73	0.69		6.75	0.76
H_2O+	-	0.52	3.20	0.06		3.21	0.06
H_2O-	-	0.09	0.43	0.10		0.43	0.11
CO_2	-	none	none	none		none	none
TiO_2	-	1.30	7.95	3.51	67.28	7.98	
P_2O_5	-	0.15	tr.	0.92		tr.	
$S(FeS_2)$	-	0.16					
MnO	-	0.03	0.58	0.24	tr.	0.58	0.25
Li_2O	-	tr.	str. tr.			str. tr.	
Total	-	99.50	99.60	99.98	100.00	100.00	100.00
Sp. Gr.	-	2.76	3.16	3.36	4.86		

A = Dacite.
B = Biotite.
C = Hypersthene.
D = Ilmenite.
E = Biotite analysis calculated to 100 per cent.
F = Hypersthene with P_2O_5 removed as Apatite and TiO_2 as Ilmenite, and calculated to 100 per cent.

Calculation of the Norm of the Dacite.

		Percentage.	Mol. Ratios.	Orthoclase.	Albite.	Anorthite.	Ilmenite.	Magnetite.	Pyrite.	Apatite.	Hypersthene.	Corundum.	Quartz.
SiO_2	-	63.27	1.054	174	228	144					109.5		398.5
Al_2O_3	-	16.50	.162	29	38	72						23	
Fe_2O_3	-	0.68	.005					5					
FeO	-	5.10	.071				16	5	2.5		47.5		
MgO	-	2.48	.062								62		
CaO	-	4.18	.075			72				3			
Na_2O	-	2.36	.038		38								
K_2O	-	2.68	.029	29									
TiO_2	-	1.30	.016				16						
P_2O_5	-	0.15	.001							1			
S	-	0.16	.005						5				

Formula.	Mol. Weight.	Mineral.	Norm.	Group.	%	Group.	%
SiO_2	.3985 × 60	Quartz	24.0	Q	24.0		
$K_2O . Al_2O_3 . 6SiO_2$	.029 × 556	Orthoclase	16.1				
$Na_2O . Al_2O_3 . 6SiO_2$	.038 × 524	Albite	19.9	F	56.0	Sal	82.3
$CaO . Al_2O_3 . 2SiO_2$	.072 × 278	Anorthite	20.0				
Al_2O_3	.023 × 102	Corundum	2.3	C	2.3		
$MgO . SiO_2$	.062 × 100	Hypersthene	12.6	P	12.6		
$FeO . SiO_2$	.0475 × 132						
$FeO . Fe_2O_3$	.005 × 232	Magnetite	1.2	M	3.6	Fem	16.8
$FeO . TiO_2$	.016 × 152	Ilmenite	2.4				
FeS_2	.0025 × 120	Pyrite	0.3	A	0.6		
$3Ca_3P_2O_8 + CaF_2$	.001 × 310	Apatite	0.3				

Class $= \frac{\text{Sal}}{\text{Fem}} = \frac{82.3}{16.8} < 7/1 > 5/3 =$ Class II. Dosalane

Order $= \frac{Q+L}{F} = \frac{24.0}{56.0} < 3/5 > 1/7 =$ Order IV. Quardofelic Austrare

Rang $= \frac{K_2O + Na_2O}{CaO} = \frac{67}{72} < 5/3 > 3/5 =$ Rang III. Alkali-calcic Tonalase

Sub-rang $= \frac{K_2O}{Na_2O} = \frac{29}{38} < 5/3 > 3/5 =$ Sub-rang III. Sodi-potassic Harzose

Calculation of Formulæ of the Minerals.

	Biotite.			Hypersthene.			Ilmenite.		
	Per cent.	Mol. Prop.	Ratio.	Per cent.	Mol. Prop.	Ratio.	Per cent.	Mol. Prop.	Ratio
SiO_2	39.86	664	6.4	55.22	920	16			
TiO_2	7.95	99					67.28	841	1.8
Al_2O_3	11.13	109	1	4.44	43	1			
Fe_2O_3	1.39	9		2.30	14				
FeO	18.10	251		22.33	310		31.92	443	
MgO	9.88	246	4.2	14.27	356	12	0.80	20	1
CaO				0.24	·4				
MnO	0.58	8		0.25	3				
Na_2O	0.35	5							
K_2O	6.73	71	2.1	0.76	7				
H_2O	3.20	178		0.06	3				

Formula $2R_2O . 4RO . R_2O_3 . 6RO_2$ $\quad 3RO . 4RO_2$ $\quad RO . 2RO_2$

Biotite - - $2(KH)_2O . 4(FeMg)O . Al_2O_3 . 6(SiTi)O_2$
Hypersthene - $3(FeMg)O . 4SiO_2$
Ilmenite - $(FeMg)O . 2TiO_2$

COMMENTS ON THE ANALYSES.

Dacite.—The composition of this dacite is seen to be quite normal, except that perhaps the TiO_2 percentage is a little higher than usual in rocks of this type. A comparison of this analysis with one of a dacite[1] from near Braemar House, Mount Macedon, shows that the two are almost identical. In composition this rock much resembles a quartz-mica-diorite from Ensay,[2] Omeo, analysed by the late Dr. Howitt, and it is interesting to note that all three fall into the same sub-rang when classified according to the American classification—viz.:—

Class II.—Dosalane.
Order IV.—Quardofelic, Austrare.
Rang III.—Alkali-calcic, Tonalase.
Subrang III.—Sodipotassic, Harzose.

The Ensay rock, however, nearly passes into subrang iv., while both the dacites are well in subrang iii.

Biotite.—The SiO_2, FeO and TiO_2 percentages are high, while the alumina and alkali percentages are low. This mineral in thin sections, under the microscope shows inclusions of ilmenite, thus the TiO_2 and FeO percentages are too high, while all the other constituents are correspondingly low. The biotite itself is believed to be titaniferrous, so that it is difficult to know how much TiO_2 to assign to the biotite and how much to the enclosed ilmenite; consequently no deduction was made from the analysis for these two oxides, with the result that the RO_2 and RO ratios are a little too high.

The formula for this mineral, according to the analysis, is $2R_2O.4RO.R_2O_3.6RO_2$. So that it is not an orthosilicate like the typical biotites.

Hypersthene.—In this analysis the FeO percentage is slightly higher than usual, while the MgO percentage is considerably lower than in a normal hypersthene, with the result that the formula for this mineral is $3RO.4RO_2$.

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1 Annual Report of the Secretary for Mines Victoria, 1907, p. 61.

2 Proc. Roy. Soc. Victoria, vol. xxii., p. 99.

Ilmenite.—The TiO_2 is extremely high, while Fe_2O_3 is absent, and MgO is present to a small extent, the FeO percentage being about normal.

The mineral is strongly magnetic, which is rather curious, as it is generally stated that only when you get a combination with magnetite does the mineral exhibit strong magnetic properties. The formula for this mineral is $RO.\ 2RO_2$.

Determination of P_2O_5 in the Analyses.

In determining this constituent by the magnesium-pyrophosphate method, according to Washington,[1] the values obtained were obviously high, consequently the method was abandoned, and that of Finkener[2] by direct determination of the ammonium phospho-molybdate, adopted with satisfactory results. Dr. H. I. Jensen[3] has encountered a similar difficulty and overcome it in this manner.

Calculation of the Mode of the Rock.

The volume percentage of each mineral in the rock was estimated by Rosiwal's[4] method. The application of this method to the rock presented considerable difficulty on account of the fine-grained groundmass, which is made up of quartz, felspar and biotite, the average diameter of these grains being only .01 mm., and that of the phenocrysts .1 mm.

In the groundmass the biotite was easily distinguished by its colour, while the slight difference in refractive index between the quartz and felspar was utilised in discriminating between these two minerals.

Sections were cut from the same sample of the rock as the analyses were made from, and as a result of traverses in several directions. Out of a total volume of 6389 the volumes of the different minerals were as shown in the accompanying table. The percentage volumes were then calculated and multiplied

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1 H. S. Washington, "Chemical Analysis of Rocks."

2 Treadwell, "Analytical Chemistry," vol. ii., p. 347.

3 Proc. Linn. Soc., N.S.W., 1907, vol. xxxii., pp. 908, et seq.

4 Verhandl d k.k. Geol. Reichsanst, 1898, pp. 143, et seq. "The Quantitative Classification of Igneous Rocks," p. 204, 1903. J. P. Iddings, Journal of Geology, vol. xii. (1904), p. 225.

by the specific gravities, giving the gravimetric proportions of the different minerals from which the percentages by weight were obtained.

A number of determinations of the felspar phenocrysts by the Michel-Lévy method resulted in the majority of them giving extinction angles for $Ab_1\ An_1$ but an occasional one for Ab_2, An_3. The specific gravities of hypersthene and ilmenite were determined by means of a small specific gravity bottle, while that of the biotite was determined by floating flakes in any position in a solution of Methylene Iodide in benzine, and then determining the specific gravity of the solution by a Westphal balance.

The specific gravity of the felspar phenocrysts was determined from a knowledge of their composition and reference to tables.

Calculation of Mode.

	Mineral.	Volume.	Percentage Volume.	Specific Gravity.	Gravimetric Proportions.	Mineral Per-centage.
Pheno-crysts	Plagioclase (Ab_1An_1) -	1629	25.50	2.68	68.34	24.13
	Hypersthene - -	656	10.27	3.36	34.50	12.17
	Biotite - - -	628	9.83	3.16	31.06	10.96
	Quartz - - -	84	1.31	2.65	3.47	1.22
	Ilmenite[1] - - -	40	0.62	4.86	3.07	1.08
Ground-mass	Felspar (Ab_9An_8) -	1553	24.31	2.675	65.03	22.95
	Quartz - - -	1389	21.74	2.65	57.61	20.34
	Biotite - - -	410	6.42	3.16	20.27	7.15
		6389	100.00		283.35	100.00

	Quartz.		Felspar.								
				Groundmass.							
	Pheno-crysts.	Ground-mass.	Pheno-crysts.	Or.	Ab.	An.	Hyp.	Bi.	Il.	Compo-sition from Mode.	Compo-sition as Ana-lysed.
SiO_2 -	1.22	20.34	13.42	5.28	5.00	3.23	6.72	7.25		62.46	63.27
Al_2O_3 -			6.83	1.51	1.42	2.75	0.55	1.97		15.03	16.50
Fe_2O_3 -							0.28	0.25		0.53	0.68
FeO -							2.72	3.29	0.35	6.36	5.10
MgO -							1.73	1.80	0.01	3.54	2.48
CaO -			2.51			1.52	0.03			4.06	4.18
Na_2O -			1.37		0.86			0.06		2.29	2.36
K_2O -				1.38			0.09	1.22		2.69	2.68
H_2O+ -							0.01	0.58		0.59	0.52
H_2O- -							0.01	0.08		0.09	0.09
TiO_2 -								1.50	0.72	2.22	1.30
MnO -							0.03	0.11		0.14	0.03
Total -	1.22	20.34	24.13	8.17	7.28	7.50	12.17	18.11	1.08	100.00	99.50[2]

1 As Phenocrysts and in the Hypersthene.

2 Including 0.15 per cent. P_2O_5 and 0.16 per cent. S (FeS_2).

From this table it will be seen how close the microscopically estimated chemical composition is to that determined by chemical analysis.

The silica has been slightly under-estimated, but as about 50 per cent. of the rock is a fine-grained groundmass with grains averaging only .01 mm. in diameter, their discrimination by means of the difference of refractive index was a matter of some difficulty.

The discrepancies between the Al_2O_3 percentages and those of the FeO and MgO suggest that the analysis of the porphyritic biotite recorded above is not representative of all the biotite in the rock.

Under the microscope, besides the large phenocrysts of biotite one sees developed granular masses of what appears to be a secondary biotite around the ilmenite, and it has been suggested by Professor Skeats that this secondary mica arises as a result of interaction between the ilmenite and felspar of the groundmass under certain conditions, and also between the hypersthene and groundmass less commonly. If that is the case it cannot be assumed that all the biotite throughout the rock is of uniform composition, but that at least we have two different kinds of biotite.

With biotite arising from ilmenite and the groundmass, one would expect a low MgO percentage, as the ilmenite is very low in this constituent, while the groundmass felspar has none; if this percentage were low the Al_2O_3 value would probably be high, so that if one knew what composition to assign to this secondary biotite it is highly probable that the Al_2O_3, FeO and MgO percentages would be more comparable.

The alkalies and lime are remarkably close, so that the felspars appear to have been correctly determined.

The ferric-iron and water are close, while discrepancies arise between the TiO_2 and MnO values. On the whole, however, the analyses are as close as one could expect to get them, considering the structure of the rock and its fine-grained groundmass, and if one could estimate the composition of the secondary biotite it is thought that the comparison would be still closer.

Another point showing the closeness of the two analyses is that the position of the rock, according to the American classi-

fication, is the same, whether calculated from the norm or mode.

SUMMARY.

The minerals hypersthene, biotite, and ilmenite occurring in the dacite have been separated and analysed. The method of separation was a combination of the use of an electro-magnet with heavy liquids and various shaking devices, and gave satisfactory results.

These minerals and also the rock were then chemically analysed, and formulae obtained for the minerals.

The norm of the rock was calculated from the chemical analysis, the mode of the rock by the application of Rosiwal's method, and from this the chemical composition of the rock was estimated microscopically. A close agreement was found to exist between the compositions obtained chemically and microscopically.

CONCLUSIONS.

The groundmass felspar appears to be a mixture of orthoclase and a plagioclase (Ab_9 An_8), and is more acid than the felspar phenocrysts, as one would expect.

In the groundmass are present all the constituents which, together with either ilmenite or hypersthene are necessary to form biotite, thus supporting the microscopical evidence of the secondary origin of some of the biotite.

It would also appear that the secondary biotite derived from the ilmenite and groundmass contains less magnesia and more alumina than the primary biotite.

In conclusion, I am much indebted to Professor E. W. Skeats for the kindly interest he has taken in this work, and for the great assistance he has rendered me whenever in difficulties, also to Mr. H. J. Grayson, whose ingenuity on many occasions simplified matters considerably.

[PROC. ROY. SOC. VICTORIA, 21 (N.S.), PT. II., 1908.]

ART. XXV.—*Contributions to the Flora of Australia, No. 10.*[1]

BY ALFRED J. EWART, D.SC., PH.D., F.L.S.,
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AND

JEAN WHITE, M.SC.,
Government Research Scholar.

(With Plates VI.–IX.).

[Read 10th December, 1908].

BAECKEA EATONIANA, n. sp., Ewart and White.

A small, much branched, shrubby plant about 5 or 6 inches high, the branches woody and stiff, and covered by a whitish membrane, peeling off on the older branches, leaving a yellowish scaly bark. Leaves about one-sixteenth inch long, glandular, green, almost cylindrical and sessile, blunt at the top, decussate. Flowers solitary, with 2 bracteoles. *Calyx*, 5 sepals, the tube adnate to the ovary, the sepals free, and with a white and membranous border. *Petals* 5, free, orbicular, shortly stalked, white, sinuous at the edge, one-twelfth inch long. *Stamens* 20, rarely 3 to 4 fewer, forming a single ring attached to a projecting ridge connected with the bases of the petals, filaments dilated more or less at the lower end, without any cilia-like appendages at the points of attachment, free from each other, filiform, as a rule 4 stamens situated opposite each petal.

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1 No. 9 in Journal Roy. Soc. of N.S. Wales, vol. xlii., 1908.

Anthers, bilobed, obcordate; stamens not quite so long as the petals. *Gynaecium.*—Ovary rough on the outside, 2-celled, the upper part very convex. Style deeply immersed, as long as the stamens. Stigma slightly bilobed.

Youndegin, W. Australia, Alice Eaton, 1894. The specimens were first examined by Mr. Luehmann, who considered its nearest affinity to be *B. pulchella.* Baron Mueller gave it the apparently unpublished name of *B. Eatoniana* (nomen nudum), which is retained in the foregoing description.

CASSINIA ACULEATA, R. Br., var IMBRICATA, F. M. Reader.

This variety, at first called "appressa," and subsequently "imbricata," was recorded in the Vict. Nat., 1905, vol. 22, p. 79. The plant proves, however, to be *Humea squamata,* F. v. M., the new variety being the result of a mistake in identification. As evidence of how easily the best of botanists may go astray with composites of this character, it may be mentioned that Baron Mueller referred his first described species to a new genus *(Haeckeria),* although aware of the existence of the prior genus of *Humea,* and that this particular species, when first collected, was named *Cassinia pholidota,* F. v. M., by Mueller, changed to *Ozothamnus pholidota,* F. v. M. (Fragm., ii., p. 131), given in Bentham's Flora as *Helichrysum pholidotum,* F. v. M., and finally recorded as though it were a new species of *Humea* (*H. squamata,* F. v. M.), in the Fragmenta, xi., p. 86, without any reference to the previous names.

GALIUM PARISIENSE, L., var. AUSTRALE, n. var.

The specimens come nearest to the variety *anglicum* of *G. parisiense,* and have usually 5-7 leaves in the whorls. The flowers, however, show a greater tendency to aggregate in small terminal clusters and the fruits are slightly smaller, dark and slightly roughened with small asperities.

Goroke, Victoria, St. Eloy D'Alton, No. 7; Goulburn R., 1892, W. Gates; Wannon R., below Hamilton, Vict., H. B. Williamson, No. 622 (no date), and same locality, Nov., 1898; Wooroloo, West Australia, Max. Koch, 1906, No. 1646.

It seems surprising that the presence of this plant in Australia has been overlooked so long, but the older specimens of it had been referred to various species of *Galium* and *Asperula* as slender varieties of them, though really quite distinct. The plant is undoubtedly native, the variety not being found elsewhere, but has not been recognised owing to its small flowers and slender character.

GNEPHOSIS BARACCHIANA, n. sp., Ewart and White
(after P. Baracchi).

A woody herb about 3 inches high. The primary stems unbranched or nearly so. Stems very slightly hairy. Leaves sparsely beset with minute hairs, lanceolate, with pointed tips, about $\frac{1}{4}$ inch long, very shortly petiolate, entire, alternate, clusters of flower heads globular, terminal, with a short peduncle and provided with 5 to 8 outer foliose bracts not projecting beyond the heads, and one to two layers of inner scarious bracts, none of which exceed the florets in length. Partial heads 1-flowered, the involucre of each floret consists of 6 outer narrow bracts, each provided near the top with a tuft of fairly long hairs, and 3 inner broader and more deciduous bracts; all the bracts are scarious and concave, and all have a midrib which is more pronounced in the outer than in the inner bracts. Receptacle convex, and roughened on the surface by the points of attachment of the florets. Florets hermaphrodite, tubular and 5-merous, the pappus consists of a flattened ring of minute scaly hairs attached to the base of the corolla. Florets somewhat hardened at the base. Anthers distinctly tailed at the base. Style branches truncate. Achene compressed and surrounded by a conspicuous mucilaginous layer, which swells up considerably in water.

Salt swamp near Mission Station, Dimboola. St. Eloy D'Alton.

This plant had been originally referred to *Angianthus*, but there are 9 bracts around each partial head of one flower. It has an external resemblance to *Gnephosis skirrophora*, but is readily distinguished by the leaf-like bracts surrounding the main heads, by the pappus and by the mucilaginous layer on the achene.

HELICHRYSUM TEPPERI, F. v. M. Lake Albacutya, 1903.

St. Eloy D'Alton. From Herbarium, C. Walter, under *Podolepis Lessoni*, Benth.

HIBBERTIA STRICTA, R. Br., var. READERI, A.J.E.

The variety comes nearest to the var. hirtiflora of *H. stricta*, but differs in the smaller flowers, more slender and glabrous stems, the leaves glabrous on their upper surfaces, and in general the pubescence less developed. The flowers, instead of the usual 8-12 stamens, have 7-10.

Casterton, 1908. F. M. Reader.

OLEARIA TOPPI, n. sp., Ewart and White (after C. A. Topp).

Shrub freely branching, apparently 1-3 feet high. Leaves $\frac{1}{3}$ to $\frac{1}{2}$ an inch long, sessile, linear, flat, somewhat thick, with a slight tendency towards recurving, midrib prominent at the back, slightly rough and glabrous. It differs from Olearia muricata, to which it has a superficial resemblance in the conspicuous revolute leaves of the latter. Leaves alternate. Heads terminal, grouped into irregular leafy corymbs, nearly sessile, and surrounded by an involucre of 3 to 5 leaf-like bracts, somewhat scarious at the edges, the bracts of the inner circle are the longest, and those of the outermost circle the shortest. Six to 7 ray florets, disc florets more numerous, 5 merous and slightly exceeding the involucre. Anther tube slightly exserted. Pappus bristles fairly numerous, not quite all the same length. Achenes hairy, greatly compressed, long and narrow.

F. M. Reader, sandy tracts, Shire of Borung, 1904; Dimboola, Mallee Scrub, 1892.

New to Victoria. The specimens were marked provisionally by Mr. Reader as *Aster decurrens*, var. *augustifolia*. It differs from this species, however, in the shorter obtusely linear leaves, the heads usually solitary at the ends of separate branches, usually 1-3 inches long, rather larger and with more numerous imbricated bracts. Achenes silky, hairy, pappus as in *Olearia decurrens*.

Mesembryanthemum bicorne, Sond. (*M. micranthum*, E. and F.).

Moorna, Lower Murray River, 1887, N.S.W.; banks of the Murray, Vict., J. P. Eckert, 1892.

Introduced, but hardly naturalised.

Mesembryanthemum sarmentosum, Haw.

This is given in the Kew Index as from S. Africa and Australia. The latter is incorrect, and is apparently given on the authority of a single old but undated specimen from "Dr. F. M. Mueller," marked Australia Felix, but with no other locality. It is evidently a fragment taken from a garden. The plant is not a native of Australia, nor is it even a naturalised alien.

Mesembryanthemum tegens, F. v. M.

This species, described in the Fragmenta, V., 157, as from low meadows near Melbourne, is retained as valid in the Kew Index as an Australian species, and at the Botanical Gardens, Melbourne, but was dropped in the Census, without any reference or reason being given. I was unable, however, to find any species with which it agreed from S. Africa or elsewhere. On reference to Kew, Mr. N. E. Brown reports as follows:—

"It would appear that the name M. tegens must stand for the plant sent. It is evidently nearly allied to M. clavellatum, Haw. (which is quite distinct from M. australe, Forst., with which Bentham united it), but that species has clavate, obtuse-angled leaves and larger, bright violet-purple flowers. From the South African M. filicaule, Haw., M., reptans, Ait., and M. crassifolium, Linn., it is also quite distinct. But there are specimens at Kew of a plant collected by Capt. Wooley Dod on Paarden Island, near Capetown, in 1897, which seems specifically the same as M. tegens. This does not appear to be described in the Flora Capensis, and no previous collector seems to have gathered it, so it is just possible that it has been introduced there from Australia. The two, however, require to be compared in the living state to make it quite certain that they are identical."

M. tegens, F. v. M., therefore, must be added to the Victorian flora; although there is a possibility it may really be of S. African origin.

PHALARIS COMMUTATA, Rosen and Schultz, Toowoomba, Canary Grass.

This unduly belauded fodder grass is considered by the Kew Herbarium to be *Phalaris bulbosa*, L., but by Hackel is considered the type of a new species (P. stenoptera, Fedde's Repertorium, v. 1908, p. 333). Several growers report that *P. canariensis* appears commonly when the plant is grown, and there is a possibility that the plant may be a mixed hybrid of *P. canariensis* with *p. arundinacea* and *bulbosa*, the *canariensis* strain predominating, and continually appearing in pure form.

STYPHELIA (SOLENISCIA) ELEGANS, D.C., var BREVIOR, n. var., Max Koch, 1907, Wooroloo, W.A., No. 1347.

The variety has some of the flowers two together in the axil of one leaf. Bentham gives them as solitary in the axils for the type, but even here very occasionally two flowers may occur to one leaf. In addition the flowers are shorter, being $\frac{1}{2}$ to $\frac{3}{4}$ inch instead of $\frac{3}{4}$ to 1 inch, and the upper half of the corolla tube is filled with dense white hairs continued over the inside of the lobes.

The history of the species is curious. Bentham in the Flora Austr. gives it as *S. tenuiflora*, Lindl., and placed it in Sect. II., Soleniscia, which he characterised by the "very slender corolla tube, *quite glabrous inside*." This latter character is copied from Lindley (Bot. Reg. 25, App., p. 25, 1839), who, however, gives the name as *S. tenuifolia*. De Candolle, Pro. vii., 737, had described the species as *Soleniscia elegans* a year previously, and noted that the inside of the corolla was hairy, and the species was transferred by Sonder (Lehm. Pl. Pr. I., 296) to Styphelia. There is, however, no justification for referring the plant to *S. tenuiflora*, Lindl. Lindley did not use this name, he gives a different description, and at a later date

than that given by De Candolle. Mueller (Census) and the Kew Index have both followed Bentham's error, which needs correction.

Thysanotus Bentianus, n. sp., Ewart and White (named after Sir Thomas Bent in recognition of the Grant by the Victorian Government of 1908 of £1000 to Research).

Herbs from one and a-half to 3 inches in height. Roots fibrous, without tubers. Leaves radical, more numerous than those of Thysanotus triandrus, which this species somewhat resembles. Leaves much shorter than in T. triandrus, and very densely beset with fairly long, rigid hairs, the hairs being more than twice as thick as any of many specimens of S. triandrus examined. The leaves are also more cylindrical than those of T. triandrus, and also the cells of the palisade parenchyma are longer than they are in T. triandrus.

Scapes simple, exceeding the length of the leaves by about half their length, while in T. triandrus the scapes are relatively longer. There is usuallly a single terminal umbel of flowers, the bracts of the inflorescence being much larger and more conspicuous than in T. triandrus, but there may be also occasionally a small umbel situated below the terminal one. Flowers much smaller than in T. triandrus and pedicels shorter, stamens 3, opposite the petals, the anthers being about the same length as the filaments. Youndegin, W. Australia, Alice Eaton, 1893.

Triglochin mucronata, R. Br.

In Bentham's Flora (vol. 7, p. 168) this is given as 1-3 inches high, or sometimes double that in luxuriant specimens, and the leaves shorter than the scape. Two forms seem, however, recognisable as varieties which do not agree in these respects.

(a) Variety *longiscapa*, n. var. The leaves are shorter than the scapes, but the latter reach a height of 8-11 inches. Murray, W. Austr., Oldfield.

(b) Variety *longifolia*, n. var. The longer leaves overtop the scapes by 1 or 2 inches and the latter are mostly 5-7 inches long. Cowcowing in lake country. M. Koch, 1904, No. 1144. A specimen from N. of the Stirling's Range, 1887, appears to be a young form of the same variety. Though so much larger than the type, both varieties appear to be annual.

Urodon.

This genus was founded by Turczaninow (Bull. Soc. Imp. de Nat de Moscou, 1894, iii., p. 16) for a specimen of Drummond's (Coll. iv., No. 21, *Urodon capitatus*), on the basis of the following characters:—

" Calyx two basal bracts, unequally bilabiate, two upper teeth broad, all with setaceous acuminate points. Corolla papilionaceous, petals clawed, standard broad emarginate, carina obtuse, wings slightly shorter. Stamens 10, filaments free. Ovary shortly stalked, biovulate, villous. Style much longer than the ovary, base scarcely dilated, pubescent, the upper part filiform and glabrous, stigma minute."

Urodon capitatus. A glabrous branching shrub, flowers in-stalked involucrate heads, standard and wings red when dry, keel dark purple. Related to Phyllota but distinguished by the shape of the calyx, stalked ovary, carina and wings.

At a later date Turczaninow distinguished a second species *U. dasyphyllus* (1853, ii., p. 268) in a specimen from Drummond's Vth. Coll., No. 47, which had been mixed with *Sphaerolobium Drummondii.* The leaves were longer, flowers larger, stems and leaves hairy, etc.

Bentham, evidently on superficial examination only, suppressed the genus and both species, and raised a new species of *Pultenaea* (*P. Urodon*, Benth.). Mueller equally incorrectly transferred these plants to *Phyllota Urodon*, F. v. M. The genus Urodon, though intermediate between *Phyllota* and *Pultenaea*, is quite distinct from both. It resembles *Pultenaea* in the shortly-stalked ovary, the thread-like style not dilated below the middle, and the flattened leaves not inrolled at the edges nor heath-like.

It resembles *Phyllota,* in the absence of a strophiole, the stamens slightly but distinctly united to the corolla at the extreme base, but differs entirely in habit, leaves and the petals all about ⅜ inch long, and other features mentioned. The style and calyx persist, the ovate pointed pod having 2 seeds on short funicles.

Urodon capitatus, Turcz.

An erect shrub apparently 1-2 feet, leaves practically sessile, the stalks decurrent, glabrous, somewhat obtuse, ½ to ⅔ c.m. long, the leaves around the heads much larger and broader, more or less purple on the backs, forming a very distinct involucre.

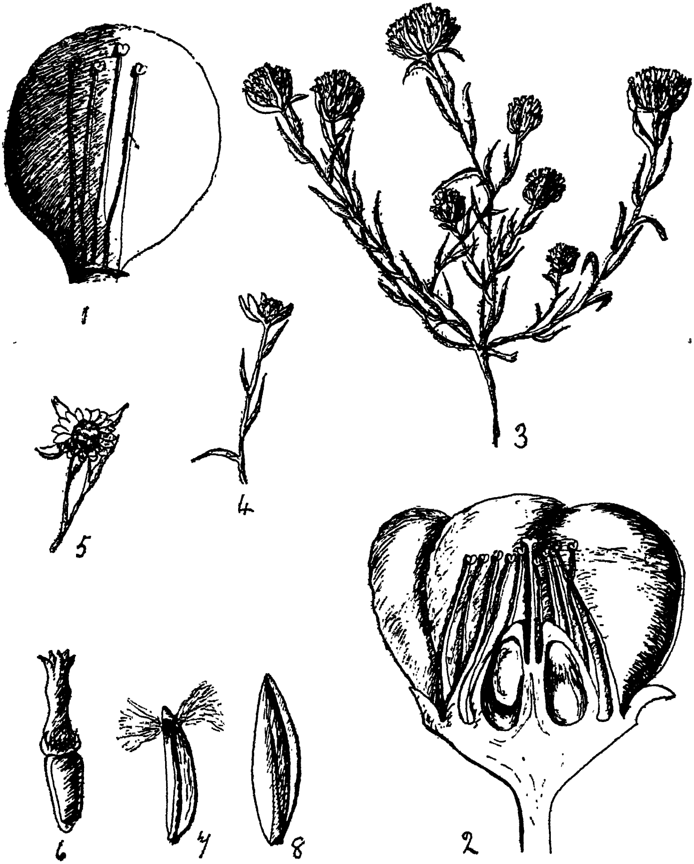
Drummond, iv., No. 21, W.A. type; M. Koch, 1905, L. Monger and Watheroo, W.A., No. 1303 (involucral leaves still broader than the type).

Urodon dasyphyllus, Turcz.

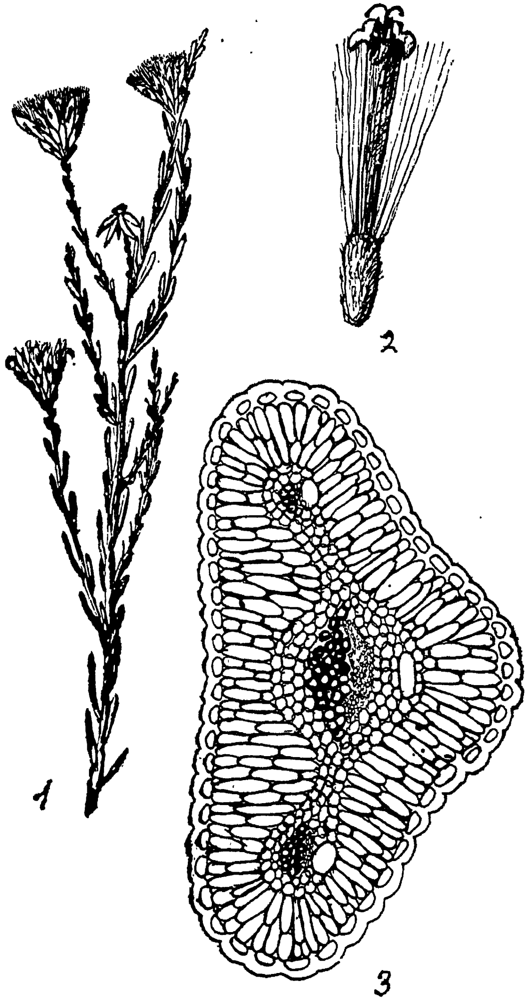
This is distinguished by its shortly but distinctly stalked leaves, which are narrower, longer (1 cm. or more), pointed and hairy. The heads are usually single, but sometimes 2 or 3 are clustered together on short separate stalks, the involucral leaves, though sometimes a little longer, do not differ appreciably from the foliage leaves. This is the plant which has been generally known as *Pultenaea* or *Phyllota Urodon.* Various localities in W. Austr. The colour varies from yellow to reddish brown, the keel usually being darker.

Var. ovalifolius, n. var. This is usually short and condensed, 6 inches or so in height, the leaves shorter, broader, very hairy, densely set. A specimen of Drummond's from W.A. links this variety to the type form having the habit of the variety, but the more pointed and narrow leaves of the type. Wangering, W. Austr., R. Helms, 1891; Coolgardie, W. Austr., McPherson, 1895; Parker's R., W. Austr., Merral, 1892.

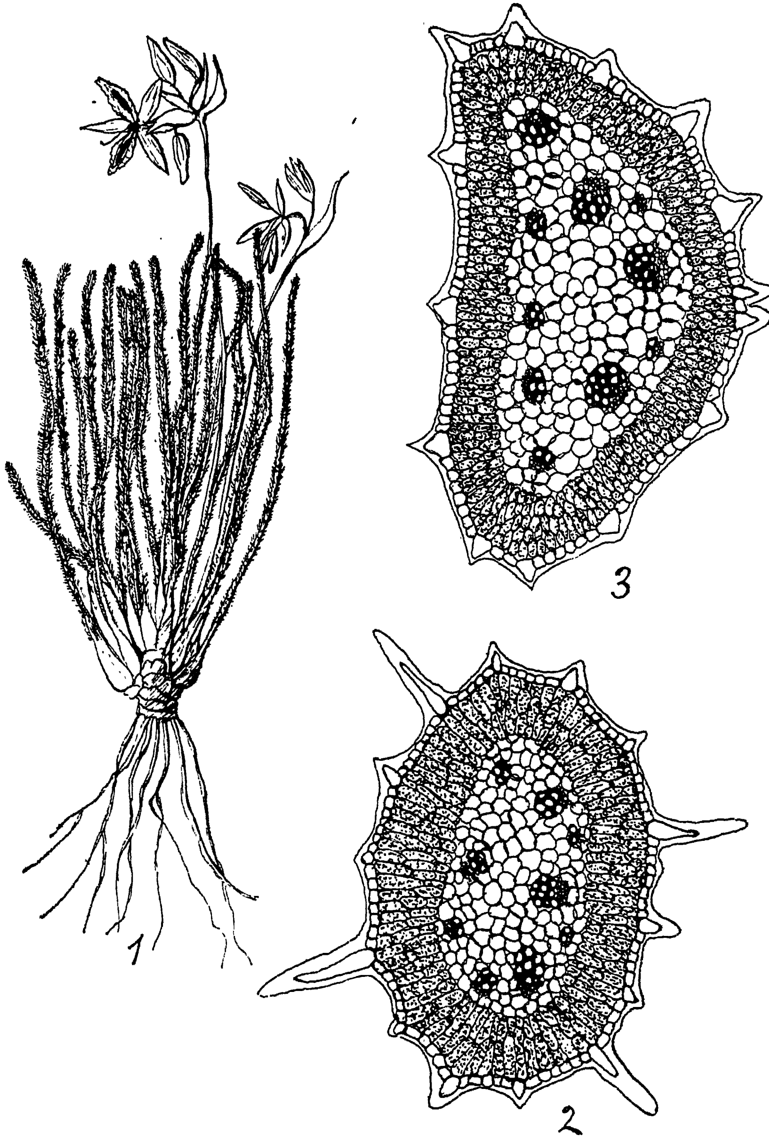
As the genus has not previously been figured, full figures of the variety are given.



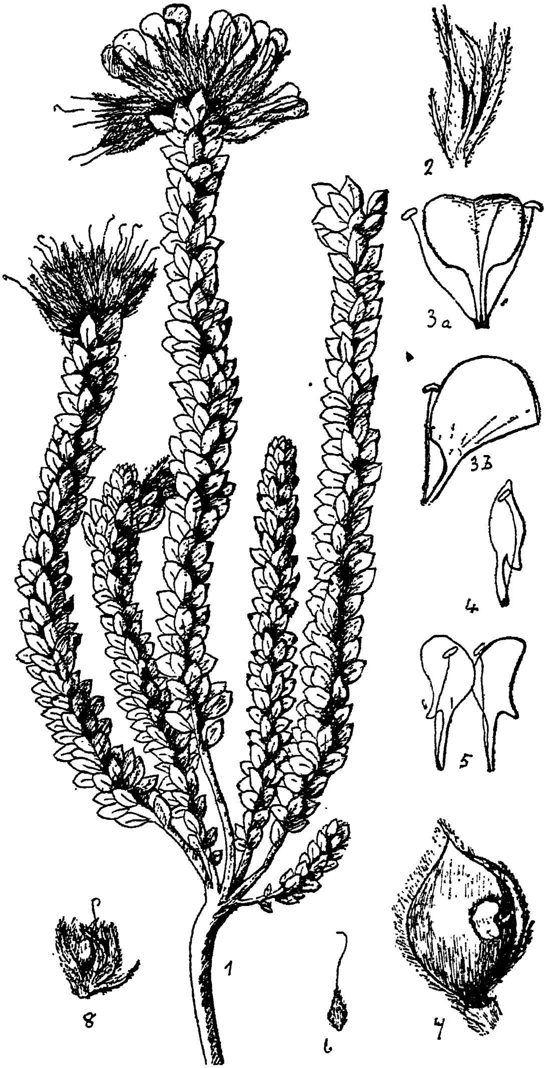
Figs. 1–2—**Baeckea Eatoniana,** Ewart and White.
Figs. 3–8—**Gnephosis Baracchiana,** Ewart and White.



Olearia Toppi, Ewart and White.



Thysanotus Bentianus, Ewart and White.



Urodon dasyphyllus, Turcz., var. **ovalifolius**, Ewart & White.

EXPLANATION OF PLATES XXX.–XXXIII.

PLATE XXX.—Figs. 1 and 2, *Baeckea Eatoniana*, Ewart and White.

Fig. 1, petal and stamens. Fig. 2, vertical section of flower. Figs. 3-8, *Gnephosis Baracchiana*, Ewart and White.

Fig. 3, entire plant; 4, side view of receptacle and general involucre 5, the same from above; 6, single floret, separated from its bracts; 7, one of the outer; 8, one of the inner bracts from a floret.

PLATE XXXI.—*Olearia Toppi*, Ewart and White.

Fig. 1. Small piece of flowering branch.
Fig. 2. Disc floret, enlarged.
Fig. 3. Transverse section of leaf, highly magnified.

PLATE XXXII.—*Thysanotus Bentianus*, Ewart and White

Fig. 1, entire plant; 2, transverse section of leaf; 3, the same of *T. triandrus.*

PLATE XXXIII.—*Urodon dasyphyllus*, Turcz., var. ovalifolius, Ewart and White.

1. Complete plant. 2. Calyx and bracteoles. 3. (a) and (b) Standard with stamens attached, front and side view. 4. Wing with stamen attached. 5. Carina. 6. Ovary. 7. Ovary-opened to show one of the seeds. 8. Fruit within calyx.

ERRATUM.

Page 540, line 10: For VI.–IX. *read* XXX.–XXXIII.

ANNUAL REPORT OF THE COUNCIL

FOR THE YEAR, 1907.

The Council herewith presents to Members of the Society the Annual Report and Details of Receipts and Expenditure for the year 1907.

The following meetings were held :

March 14th—Annual Meeting and Election of Officers. Ordinary Meeting. No papers were read.

April 11th—Papers read: 1. "A Living Descendant of an Extinct (Tasmanian) Race," by Prof. R. J. A. Berry, M.D., &c. 2. "A Note on the Bedding of Tuffs," by T. S. Hall. 3. "A New Chiton from North Queensland (Enoplochiton torrii," by R. A. Bastow and J. H. Gatliff. 4. "Additions to the catalogue of Marine Shells of Victoria," by J. H. Gatliff. Exhibits: Specimens of Enoplochiton torrii in illustration of their paper, by Messrs. Bastow and Gatliff.

May 9th—A Lecture was delivered by Mr. A. C. H. Rothera, M.A., entitled "Life and Death."

June 13th—Papers read: 1. "Fossil Fish Remains in the Tertiaries of Australia, Part II.," by F. Chapman, A.L.S., and G. B. Pritchard, F.G.S. 2. "The Movements of the Soluble Constituents in Fine Alluvial Soils," by Prof. A. J. Ewart, D.Sc., Ph.D. Exhibit: A dry cell ten years old and still active, by J. A. Smith.

July 11th—A Lecture entitled "Some recent discoveries on the protection of the body against disease," by Dr. R. J. Bull. The paper was illustrated by lantern slides. Paper read: "Contributions to the Flora of Australia, Part 6," by Prof. A. J. Ewart. Exhibits: Microscope slides in illustration of Dr. Bull's lecture, by O. A. Sayce. Plants dealt with in his paper, by Prof. A. J. Ewart.

August 8th—The following demonstrations were given: 1. Determination of the length of the vessels in tree-stems by

means of mercury. The injection had been made in the University Laboratory by Miss Rees. 2. Prof. Ewart showed transverse sections of wood mounted as lantern slides. Dr. H. Green showed a new form of barometer devised by himself. 4. Mr. O. A. Sayce showed slides of Nitrogen bacteria of the soil and explained the mode of obtaining pure cultures. 5. Mr. Kershaw showed the fore-limb of an ox in which the two digits had fused to form a single bone with a single hoof.

September 12th—A series of lantern slides illustrating the geology and physiography of the Victorian coast was exhibited by R. H. Harvey and T. S. Hall.

October 10—Paper read: "The Geology of Mooroodue in the Mornington Peninsula," by Prof. E. W. Skeats. Exhibits: Mr. E. J. Dunn exhibited: 1. Eclogite from Transvaal; 2. Thorianite from Ceylon; 3. Monazite from Queensland. Mr. T. S. Hall exhibited abnormally grown teeth of a rabbit and teeth of shark, walrus, horse and crocodile in illustration of his remarks.

November 14th—Members of the House and Printing Committee for the following year were elected. Papers read: 1. "On the Formation of Red-wood in Gymnosperms," by Miss J. White, M.Sc. 2. "On the Validity of Callitris morrisoni," by R. T. Baker. 3. "Contributions to the Flora of Australia, Part 7," by Prof. A. J. Ewart. 4. "On the Occurrence of a Marsupium in an Echinoid belonging to the Genus Scutellina," by T. S. Hall. Exhibits: 1. Mr. Hall showed specimens in illustration of his paper. 2. Mr. Chapman showed devitrified glass from the great fire of Chicago, together with microscope slides of the same.

December 12th—The auditors were appointed for the year. The following papers were read:—1. "Contributions to our knowledge of the Anatomy of Australian Batrachia," by Miss G. Sweet, D.Sc. 2. "The Highlands and Main Divide of Western Victoria," by T. S. Hart, M.A., F.G.S. 3. "New or little-known Victorian Fossils in the National Museum, Pt. IX."—Some Tertiary Species, by F. Chapman, A.L.S. Exhibits: Mr. Chapman showed the species dealt with in his paper.

The Council desires to thank Mr. A. C. H. Rothera, and Dr. R. J. Bull for the lectures they delivered before members of the Society.

During the year one member and four associates were elected, and three members and three associates resigned. In addition two honorary and two ordinary members and one associate have died.

Robert Lewis John Ellery, C.M.G., F.R.S., F.R.A.S., was born in England, on July 14th, 1827. He arrived in Australia at the end of 1851, and established the Williamstown Observatory in 1853. He organised the Torpedo Corps in connection with the Defence Force in 1873, and rose to the position of colonel. He joined the Royal Society of Victoria in 1856. He was elected to the Council in 1863, and was Secretary in 1864, and Vice-President in 1865. In 1867 he became President, and held this office till 1884, a period of eighteen years. He then served on the Council till the end of 1905, when he declined re-election. He was Director of the Geodetic Survey from 1858 to 1874. Elected F.R.A.S., 1859; F.R.S., 1863; and was created C.M.G. in 1889. In 1895 he retired from the directorship of the Observatory, died on January 14th, 1908. His energy long made him the mainspring of our Society, and his resourcefulness helped us in many a time of difficulty. Including several Presidential Addresses and a few papers represented by title only, Mr. Ellery is represented by 73 papers in the publications of our Society, his communications being concerned mainly with physical and astronomical questions. Mr. Ellery's kindly nature and fund of humour made him a universal favourite, and he passed away loved and respected by all.

John Dennant, F.G.S., joined the Society in 1886, and died on June 13th, 1907. His work as Inspector of Schools entailed a good deal of travelling, and he had a wide knowledge of Victorian Geology. He contributed several papers on tertiary geology to our Society, both by himself and in conjunction with others. Most of his work however appeared in the Transactions of the Royal Society of South Australia, where he wrote with Professor R. Tate on Tertiary Geology, and alone on Corals, both recent and fossil. He was a President of this Society, and acted on the Council for many years.

Henry Chamberlain Russell, C.M.G., B.A., F.R.S., an Honorary Member of the Society, was born in New South Wales

in March, 1836. He was appointed Government Astronomer of that State in 1870 and died on February 22nd, 1907. Mr. Russell's writings appeared chiefly in publications of his Observatory and in those of our sister Society in New South Wales. He was one of the Founders and a Trustee of the Australasian Association for the Advancement of Science.

Lorimer Fison, M.A., D.D., was educated at Caius College, Cambridge. After some years in Australia he became a Methodist Missionary to Fiji. While there he contributed largely to L. H. Morgan's work on Systems of Consanguinity. On returning to Australia he studied the social organisation and marriage relationship of the Australian tribe, and in conjunction with Dr. A. W. Howitt published "Kamilaroi and Kurnai," which laid the foundation of the scientific study of Australian Aborigines. He published several papers in the Journal of the Anthropological Institute. After a long period of infirmity he died at Essendon on 29th December. In recognition of his scientific services he was granted a pension on the Civil List by the British Government.

Sir James Hector, K.C.M.G., M.D., F.R.S., late director of Geological Survey of New Zealand, was elected an honorary member in 1888.

The Government has at last been moved by our necessities, and has given us an additional £50 towards publication. Our total grant is now £100 per annum, and the Society is grateful for this amount of support given to its work. A portion of the ground belonging to the Society has been leased to the Commonwealth Meteorological Bureau as a site for an observing station for the Metropolitan area. It is proposed to devote the amount received as rent to improvements and repairs to the house and grounds, which are sadly in need of attention.

A conference was summoned by Professor W. Baldwin Spencer to consider the question of the Reservation of Wilson's Promontory as a National Park. The Council appointed Mr. J. A. Kershaw its representative. Certain recommendations were agreed to, and a deputation to the Minister of Lands was very well received. It was promised that the reserve would be made permanent, that it would be vested in trustees, and that the

amount received from grazing rights would be handed over to the trustees for maintenance. The final arrangements have not yet been made.

During the year there was an unusual dearth of papers presented to the Society, but we begin the present year with a much better outlook in that respect, and several lengthy papers are under consideration by the Council.

The Hon. Librarian reports as follows :—

During the year 1907, 1478 publications were added to the Library, while 159 volumes were bound. As many important publications are still unbound I should like to suggest that a further sum be voted for this purpose.

The question of additional shelving is becoming an urgent one; if the proposals of the Sub-committee appointed to report on this matter be adopted, ample accommodation will be provided for many years.

The Honorary Treasurer in Account with the Royal Society of Victoria.

Dr.	£	s.	d.	Cr.	£	s.	d.
To Balance from 1906	£163	8	4	By Printing	£124	19	6
Government Grant	50	0	0	Postages and Petty Cash	15	16	5
Subscriptions—				Advertisements, Freights and Sundries ...	2	10	1
Members	27	6	0	Assistant-Secretary	29	3	4
Country Members	3	3	6	Hall Keeper	6	0	0
Associates	21	0	0	City Rates	3	13	4
Arrears	16	16	0	Insurance	5	1	3
Advance Payments	1	1	0	Collector's Commission	13	15	2
Subscriptions collected by Collector ...	88	4	0	Sewerage and Water	25	17	10
Rent	15	10	0	Gas	3	5	11
Sale of Publications	5	2	4	Refreshments and Cleaning	5	2	5
Balfe (Refund)	0	2	6	New Crockery	1	10	0
				Book-binding	23	5	0
				Periodicals	6	7	0
				Lantern	2	5	0
				Repairs	3	2	6
				Illustrating Journal	10	17	6
				Bank Charges	0	10	0
					£283	2	3
				Balance	108	11	5
	£391	13	8		£391	13	8

Compared with the Vouchers, Bank Pass-Book, and Cash-Book, and found correct,

(Signed) J. SHEPHARD, *Hon. Treasurer.*

(Signed) WM. A. HARTNELL, JAMES E. GILBERT, } *Auditors.*

4th March, 1908.

Royal Society of Victoria.

1908.

Patron:

SIR REGINALD TALBOT, K.C.B.,
Succeeded by
SIR THOMAS GIBSON CARMICHAEL, BART.

President:

P. BARACCHI, F.R.A.S.

Vice-Presidents:

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PROF. R. J. A. BERRY, M.D., F.R.S.E.

Hon Treasurer:

J. SHEPHARD.

Hon. Librarian:

R. D. BOYS, B.A.

Hon. Secretary:

T. S. HALL, M.A., D.Sc.

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W. A. HARTNELL.
C. E. OLIVER, M.C.E.
E. J. DUNN, F.G.S.
PROF. W. C. KERNOT, M.A., M.C.E.
PROF. W. BALDWIN SPENCER, C.M.G., M.A., F.R.S. *replaced by*
F. WISEWOULD.
G. SWEET, F.G.S.
R. H. WALCOTT, F.G.S
E. J. WHITE, F.R.A.S.

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P. DE J. GRUT.
G. SWEET, F.G.S.

Printing Committee:

THE HON. TREASURER.
THE HON. SECRETARY (CONVENER).
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1908.

LIST OF MEMBERS,

WITH THEIR YEAR OF JOINING.

Patron.

His Excellency Sir Thomas Gibson-Carmichael, Bart. ... 1908

Honorary Members.

Forrest, The Hon. Sir J., K.C.M.G., West Australia ... 1888

Liversidge, Professor A., LL.D., F.R.S. 1892

Neumayer, Prof. George, Ph.D., F.R.S., Neustadt a.d. Haardt, Germany 1857

Scott, Rev. W., M.A., Kurrajong Heights, N.S.W. 1855

Todd, Sir Charles, K.C.M.G., F.R.S., Adelaide, S.A. 1856

Verbeek, Dr. R. D. M., Buitenzorg, Batavia, Java 1886

Life Members.

Butters, J. S., F.R.G.S., Empire Buildings, Collins-street west 1860

Eaton, H. F. 1857

Fowler, Thos. W., M.C.E., Colonial Mutual Ch., 421 Collins-street, Melbourne 1879

Gibbons, Sydney, F.C.S., 31 Gipps-street, East Melbourne. 1854

Gilbert, J. E., "Melrose," Glenferrie-road, Kew 1872

Love, E. F. J., M.A., D.Sc., F.R.A.S., 213 Victoria Terrace, Royal Park 1888

Nicholas, William, F.G.S. 1864

Rusden, H. K., Glenhuntly-road, Elsternwick 1866

Selby, G. W., 99 Queen-street, Melbourne 1881

White, E. J., F.R.A.S., Observatory, Melbourne 1868

ORDINARY MEMBERS.

Balfour, Lewis, B.A., M.B., B.S., Burwood-road, Hawthorn 1892
Baracchi, Pietro, F.R.A.S., Observatory, Melbourne 1887
Barnes, Benjamin, Queen's Terrace, South Melbourne ... 1866
Barrett, A. O., "Melisse," Bruce-street, Toorak 1908
Bavay, A. F. J. de, Foster Brewery, Collingwood 1905
Boys, R. D., B.A., Public Library, Melbourne 1903
Berry, Prof. R. J. A., M.D., F.R.S.E., University ... 1906

Cherry, T., M.D., M.S., Department of Agriculture, Melbourne 1893
Cohen, Joseph B., A.R.I.B.A., Public Works Department, Melbourne 1877

Dunn, E. J., F.G.S., "Roseneath," Pakington-street, Kew 1893

*Ewart, Prof. A. J., D.Sc., F.L.S., University, Melbourne 1906

Fox, Dr. W. R., L.R.C.S., L.R.C.P., 90 Collins-street Melbourne 1899
Fryett, A. G., care Dr. F. Bird, Spring-street, Melbourne 1900

Gault, Dr. E. L., M.A., M.B., B.S., Collins-street, Melbourne 1899
Gillott, The Hon. Sir S.. K.C.M.G., 'Edensor," Brunswick-street, Fitzroy 1905
Griffiths, R. F., Commonwealth Meteorological Bureau, Carlton 1908
Grut, P. de Jersey, 125 Osborne-street, South Yarra ... 1901

Hake, C. N., F.C.S., Melbourne Club, Melbourne 1890
Hall, T. S., M.A., D.Sc., University, Melbourne 1890
Hartnell, W. A., "Irrewarra," Burke-road Camberwell ... 1900
Harvey, J. H., A.R.V.I.A., 128 Powlett-street, East Melbourne 1895
Heffernan, E. B., M.D., B.S., ... 1879
Hooper, Dr. J. W. Dunbar, M.D., L.R.C.S., etc., Collins-street, Melbourne 1904

Hunt, H. A., Commonwealth Meteorological Bureau, Carlton 1908

Jamieson, James, M.D., 96 Exhibition-street, Melbourne 1877

Kernot, Professor W. C., M.A., M.C.E., University, Melbourne 1870
Kernot, W. N., B.C.E., Working Men's College, Melbourne 1906
Kershaw, J. A., F.E.S., National Museum, Swanston-street 1900
Kitson, A. E., F.G.S. 1894

Leach, A. J., M.Sc., Education Department, Melbourne 1904
Lyle, Prof. T. R., M.A., University, Melbourne 1889
Loughrey, B., M.A., M.D., Ch.B., M.C.E., 1 Elgin-street, Hawthorn 1880

Masson, Prof. Orme, M.A., D.Sc., University, Melbourne 1887
Michell, J. H., M.A., F.R.S., University, Melbourne 1900
Mills, A. L., University, Melbourne 1903

Nanson, Prof. E. T., M.A., University, Melbourne 1875

Oliver, C. E., M.C.E., Metropolitan Board of Works, Melbourne. 1878

Rowe, W. C., "Invicta," Chaucer-street, Canterbury ... 1908

Schlapp, H. H., 31 Queen-street, Melbourne 1906
Shephard, John, Clarke-street, South Melbourne 1894
Skeats, Prof. E. W., D.Sc., University, Melbourne 1905
Spencer, Prof. W. Baldwin, C.M.G., M.A., D.Sc., F.R.S., University, Melbourne 1887
Sugden, Rev. E. H., M.A., B.Sc., Queen's College, Carlton 1899
Sweet, George, F.G.S., Wilson-street, Brunswick 1887
Swinburne, The Hon. G., M.L.A., "Shenton," Kinkora-road, Hawthorn 1905

Tait, Thos., "Lanark," Queen's-road, South Melbourne ... 1905
Taylor, R., 31 Queen-street, Melbourne 1907

Walcott, R. H., F.G.S., Technological Museum, Swanston-street 1897
Ware, S., M.A., Education Department, Melbourne 1901
Wisewould, F., 408 Collins-street, Melbourne 1902

Country Members.

Brittlebank, C. C., "Dunbar," Myrniong, Victoria 1898

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Hart, T. S., M.A., B.C.E., F.G.S., School of Mines, Ballarat 1894
Hogg, H. R., M.A., 2 Vicarage Gate, Kensington, W. ... 1890

Ingram, Alex., Hamilton, Victoria 1903

Maplestone, C. M., Eltham, Victoria 1898
Mennell, F. P., Rhodesian Museum, Buluwayo, South Africa 1902
Murray, Stuart, C.E., "Morningside," Kyneton 1874

Oddie, James, Dana-street, Ballarat, Victoria 1882
Officer, C. G. W., B.Sc., "Kallara," Bourke, N.S.W. 1890

Corresponding Members.

Bailey, F. M., F.L.S., Government Botanist, Brisbane, Queensland 1880

Dendy, Professor Arthur, D.Sc., F.L.S., King's College, London 1888

Etheridge, Robert, Junr., Australian Museum, Sydney, N.S.W. 1877

Lucas, A. H. S., M.A., B.Sc., Sydney Grammar School, Sydney, N.S.W. 1895

Stirton, James, M.D., F.L.S., 15 Newton-street, Glasgow 1880

Associates.

Anderson, J., 225 Beaconsfield Parade, Middle Park 1903
Armitage, R. W., Continuation School, E. Melbourne 1907

Bage, Mrs. Edward, "Cranford," Fulton-street, St. Kilda 1906
Bage, Miss F., M.Sc., Fulton-street, St. Kilda 1906
Baker, Thomas, Bond-street, Abbotsford, Victoria 1889
Bale, W. M., F.R.M.S., Walpole-street, Hyde Park, Kew, Victoria 1887
Bennetts, W. R., Pakington-street, Kew 1894
Booth, John, M.C.E., 25 Rathdown-street, Carlton 1872
Brook, R. H. T., 119 Errard-street, Ballarat 1906

Chapman, F., A.L.S., National Museum, Melbourne 1902
Clendinnen, Dr. F. J., Williams-road, Toorak 1906
Corbett, J., "Clifton," 39 Rushall-crescent, N. Fitzroy ... 1907

Danks, A. T., 391 Bourke-street West, Melbourne 1883

Ferguson, W. H., "Maryland Villa," Camberwell-road, Camberwell 1894
Finney, W. H., 40 Merton-street, Albert Park 1881
Fulton, S. W., 369 Collins-street, Melbourne 1900

Gabriel, C. J., Victoria-street, Abbotsford 1908
Gabriel, J., Victoria-street, Abbotsford, Victoria 1887
Gatliff, J. H., Commercial Bank of Australasia, Lygon-street, Carlton 1898
Grant, Kerr, M.Sc., 49 Park-street, Brunswick 1905
Green, W. Heber, D.Sc., University, Melbourne 1896
Grayson, H. J., University, Melbourne 1902

Hardy, A. D., F.L.S., Lands Department, Melbourne 1903
Henderson, A. A., M.Sc., School of Mines, Box 12, Bairnsdale 1905
Herman, Hyman, B.C.E., F.G.S., 60 Queen-st., Melbourne 1897
Hunter, S. B., Department of Mines, Melbourne 1908

Jobbins, G. G., Electric Lighting and Traction Co., Geelong 1902
Jutson, J. T., "Oakworth," Smith-street, Northcote 1902

Kenyon, Mrs., A. F., Highett-street, Richmond 1908
Kenyon, A. S., Heidelberg 1901
Kernot, Frederick A., 57 Russell-street, Melbourne 1881

Lambert, Thomas, Bank of New South Wales, Collins-street, Melbourne 1890
Lambie, J., 29 Illawarra-road, Hawthorn 1908
Larking, R. J., "Woorigoleen," Clendon-road, Toorak ... 1905
Luly, W. H., Department of Lands, Treasury, Melbourne 1896

Mitchell, S. R., Carrington-grove, E. St. Kilda 1908
Muntz, T. B., C.E., Wattletree-road, Malvern 1873
Maclean, C. W., "Bronte," Strand, Williamstown 1879
Mahony, D. J., B.Sc., "Locksley," St. Kilda-rd., Melbourne 1904
Mathew, Rev. John, M.A., B.D., Coburg 1890
McEwan, John, 317 Collins-street 1898
McKenzie, G., Lands Department, Melbourne... 1907
Miller, E. E., Boundary-road, Toorak 1908

Nicholls, E. B., 164a Victoria-street, N. Melbourne 1904
Nimmo, W. H. R., B.C.E., 793 Punt-road, S. Yarra ... 1908

O'Neill, W. J., Lands Department, Melbourne 1903

Pritchard, G. B., B.Sc., F.G.S., Mantell-street, Moonee Ponds 1892

Sayce, O. A., Harcourt-street, Hawthorn 1898
Schafer, R., "Invercloy," Napier-street, Essendon 1883
Smith, J. A., 15 Collins-place, Melbourne 1905
Summers, H., B.Sc., 49 Airlie-street, S. Yarra 1902
Sutton, C. S., M.B., B.S., Rathdown-street, N. Carlton 1908
Sutherland, Ian M., M.C.E., "Novar," Dandenong 1905
Sweet, Miss G., D.Sc., Wilson-street, Brunswick 1906

Thorn, Wm., Lands Department, Melbourne 1907
Thiele, E. O., B.Sc., c/o O. A. Thiele, "Evandale," Chatham-road, Canterbury 1898
Traill, J. C., B.A., B.C.E., "Osmington," Domain-road, South Yarra 1903

Wedeles, James, 231 Flinders-lane, Melbourne 1896
White, Miss R. E. J., M.Sc., Observatory Quarters, S. Yarra 1908
Woodward, J. H., Queen's Buildings, Rathdowne-street, Carlton 1903

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(*The names of new species and genera are printed in italics.*)

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